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PLASTICS TECHNOLOGY

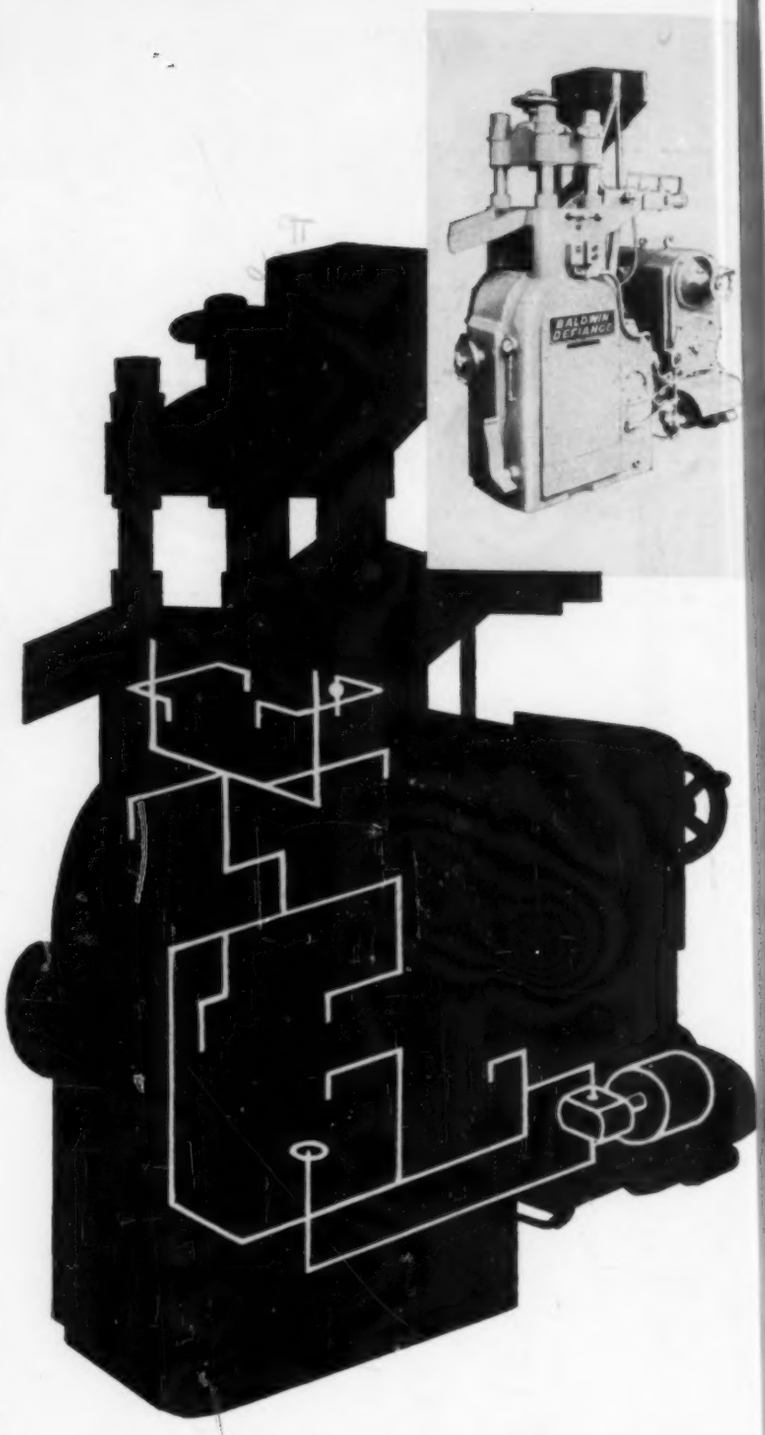
THE MAGAZINE OF APPLIED ENGINEERING

A BILL BROTHERS PUBLICATION

NEW FIELDS TO CONQUER
—THE FUTURE OUTLOOK

an article by J. [illegible]

BALDWIN plastics presses reduce downtime with SAFEGUARD LUBRICATION



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VOLUME 1, NUMBER 1

NEW FIELDS TO CONQUER ..... Johan Bjorksten 13
The outlook for continuing plastics expansion based on reductions in fabricating cycle tim and material costs.

MOLDED ACRYLIC PRISMS USED IN NEW OUTDOOR SIGN 19

PLASTIC TOOLING FOR PLASTIC PARTS .. Walter Brenner and Eugene Singer 20
Advantages, disadvantages, manufacture and applications of plastic tools for use in molding or forming of plastic parts.

COOPERATION BETWEEN SUPPLIERS ..... A. L. Heston 26
A GUEST EDITORIAL

CAM ACTIONS FOR INJECTION MOLDS ..... William Lewi 27
The growing complexity of molded parts is placing even greater emphasis on cam action injection molds.

NEW PROCESS GIVES SMOOTH FINISH ON GLASS-REINFORCED PLASTICS .. 30

THE KREIDL PROCESS FOR BETTER PRINT ADHESION ON POLYETHYLENE
Werner H. Kreidl and Frederick Hartmann 31
A rapid, continuous process, available in engineered installations, for treating polyethylene to permit use of standard inks and other coatings.

INTRODUCING OUR EDITORIAL ADVISORY BOARD 37

FEATURE DEPARTMENTS

Letters to the Editor	4	New Materials	50
News in Brief	9	New Equipment	51
Editorial	11	New Products	54
News of the Societies	39	Book Reviews	57
Calendar of Coming Events	64	New Literature	56
News of the Industry	42	Abstracts of Important Articles	58
News from Abroad	47	Patent Digest	60
Names in the News	48	Resins: Production and Sales	62
Obituaries	49	Current Market Prices	65

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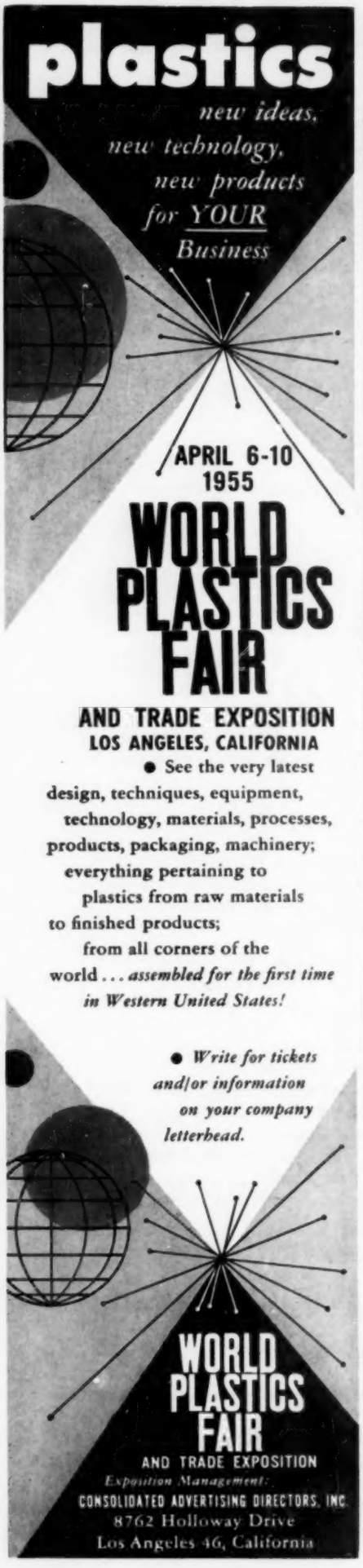


Letters to the Editor

We feel sure that your new publication will fill a void long needed in our industry.

George W. Leaf, President
Leaf Plastics, Inc.
Yonkers, New York

May we take this opportunity to wish you every possible success in your new publication. We will gladly contribute any technical assistance that we can.

John E. David, General Manager
The Fiberite Corporation
Chicago, Illinois

Sounds like a good thing for the industry.

Allen W. Schmidt
Resin Industries
Santa Barbara, California

The first issue of your publication, "Plastics Technology" is being awaited by our company with much interest.
The need for a trade journal to convey the latest and most advanced technics and developments in the field of plastics to the engineers of our industry has long been acute.

G. Palmer Humphrey, Vice President
R. C. Molding, Incorporated
New Hyde Park, L. I., N. Y.

We definitely feel that there is room within the plastics industry for a magazine of this nature for the technical man.

Conrad R. Hoffmann, Treasurer
Industrial Plastic Fabricators, Inc.
Norwood, Massachusetts

Should be a very interesting magazine. It certainly is needed in the plastic industry.

R. F. Duncan
Manager, Color Division
Ferro Corporation
Cleveland, Ohio

Certainly wish you success in this venture. . . . We at Camfield Plastics Division are looking forward to participating.

Mario J. Petretti
Manager, Plastics Division
Camfield Manufacturing Company
Grand Haven, Michigan

We note with interest the forthcoming publication of Plastics Technology. There is a definite need for a source of technical information for the plastics industry.

Jay Steiner
F. J. Stokes Machine Company
Philadelphia, Pennsylvania

May we take this means of wishing you success as the editor and of saying we hope that you can achieve your objective of a Technical Magazine. I personally feel that the shortcoming of most technical articles is that they leave out the most important part and that is the time, temperature and pressure elements. It does little good to say "a fast cycle" or "reduced temperature" since these terms are only relative.

Wayne I. Pribble
Barrier-Pribble and Company, Inc.
New Haven, Indiana

There has long been a need for a publication such as yours, to gather and disseminate practical technical information for people in our field.

Harold H. Schwartz
Plastics Division Manager
Empire Brushes, Inc.
Port Chester, New York

We wish to congratulate you on taking a step in the right direction in your proposed publication to be known as Plastics Technology, as we feel that you will fill a long needed want by our rapidly growing and expanding industry.

Herb J. Weber, Manager
Waljohn Plastics, Inc.
Industrial Division
Brooklyn, New York

The plastics industry, being so new, has not yet developed the basic understanding of the scientific principles, which pertain to our processes. The subjects of polymerization, modified hydraulic flow, thermal characteristics, standards, etc., which are our scientific fundamentals, are in their infancy. As a matter of fact, we do not even have hypotheses with which to speculate on many of our most important phenomena. At the moment, the industry as a whole, particularly the ultimate fabricator, uses trial and error based on our limited experience, to solve most of our immediate problems.

NEWS in BRIEF

Gain in resin production predicted for 1955. Production last year was about 1,357,000 tons, or 3% below the record totals of 1953. SPI expects output in 1955 to reach a new high of 1,424,500 tons, and the total value of all finished plastic products to rise to $1,425 million. The 1954 decline can be considered a normal adjustment, SPI says, and an industry-wide recovery movement is now clearly evident. Among products earmarked as good business prospects this year are vacuum formed parts, styrene wall tile, piping, reinforced plastics, and film and sheeting.

Announcements of company expansions in plastics continue to come thick and fast. In addition to anticipated increases in sales of its established materials (polyesters, phenolics, ureas, melamines and alkyds), Barrett Division of Allied Chemical & Dye recently introduced a polyethylene wax mold release agent, and will soon announce a new nylon molding compound.

Reichhold Chemicals expects to broaden its chemical products by intensified research, particularly in reinforced plastics.

New plant construction and expansions of present production facilities by Koppers in 1955 will take more than $20 million. A major portion of this total is earmarked for the upcoming polyethylene plant in Texas, which is scheduled for completion late this year.

American Cyanamid is completing plans to enter the thermoplastics field with new styrene polymers and copolymers. Construction is under way for a new unit to produce some 40 million pounds annually of thermoplastic molding compounds, and another to make intermediates.

Chemical industry construction projects during 1954 totaled over $1 billion, says MCA president Foster. Another $1.5 billion is either under construction or planned for completion within the next three years. This expansion supports the Paley Report prediction that the chemical industry will quadruple its productive capacity by 1975.

Progress in machinery development must keep pace with the rapid development of new materials, says vp Heston of NRM, extruder manufacturer. Real progress requires the cooperation of the machinery maker and the materials suppliers, and the actual testing of new materials on new machine designs. (See guest editorial, page 26).

Elimination of mat prints from surfaces of glass-reinforced plastic parts without further coating is claimed for Lunn Industries' new process — Finish No. 107. A covering layer of non-woven cotton fabric is used to mask the glass pattern and give a smooth finish to the part.

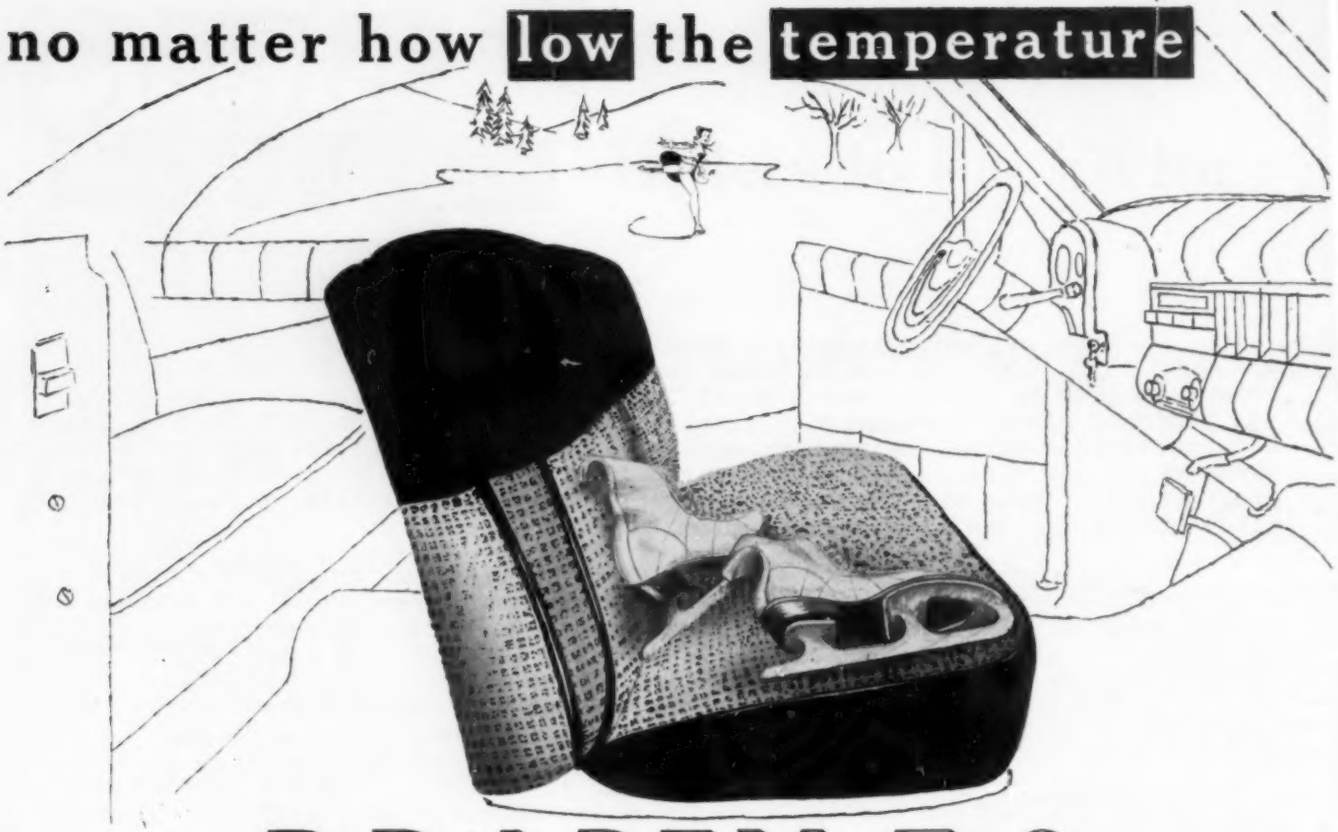
SPE national officers elected at the 1955 conference were: president – Frank W. Reinhart, National Bureau of Standards; vice president – Ernest P. Moslo, Moslo Machinery Co.; secretary – Jules W. Lindau, III, Southern Plastics, Inc.; and treasurer – Haiman S. Nathan, Atlas Plastics, Inc. A new high of 1,700 registrants was set at the meeting.

Expanded plastics were discussed at a recent SPE New York Section meeting. Individual talks covered silicone, phenolic, isocyanate, vinyl, cellulose acetate, and polystyrene foams.

New developments in materials (see page 50) include an alcohol phthalate type plasticizer; an oil-resistant white marking ink; a pressure sensitive adhesive for plastics; a PVC resin for high temperature processing; and three emulsifiable polyethylenes.

New equipment announced (see page 51): a weigh-feeder for injection machines; wire thread inserts for plastic parts; an electric welding gun for thermoplastics; a line of C-frame hydraulic presses; automatically locking hose couplings; a series of pelleting machines; a pelletizer for extruded plastic strands; a redesigned plastics grinder; and a planer for flat sheet.

no matter how low the temperature



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PLASTICS TECHNOLOGY

FEBRUARY, 1955

EDITORIAL: A New Industrial Magazine Is Born

This is the first issue of PLASTICS TECHNOLOGY—a new publication concerned primarily with the technical aspects of the plastics industry, and edited for the technical men in production, research, development, sales service and management.

It is a logical outgrowth of the Plastics Section of RUBBER WORLD, another Bill Brothers publication, and is timed to meet the needs for a publication which will report and review the technological advance of the industry.

•

This issue, Volume 1, Number 1, presents a physical sample of the editorial formula we have developed out of the thoughtful suggestions of hundreds of plastics technologists who have given freely of their time and effort because of their realization of the need for such a publication. Here, all material will be carefully selected and edited for value to the reader, and presented in an honest, factual and comprehensive manner. Of necessity, some of our editorial aims are long-range in nature, but we expect to achieve them in due course of time.

Certainly, in presenting PLASTICS TECHNOLOGY we do not assume to infringe upon the well-earned franchises of other established publications. Rather, we expect to carve out our individual niche and by intelligence and integrity thus serve those responsible for the extraordinary and rapid development of their industry. As *"The Magazine of Applied Engineering"* it will be our special mission to chronicle and interpret the Industry's advance and direction in a lively and interesting, but always accurate and unbiased fashion.

The plastics industry is now coming of age after an infancy associated with inflammable collar buttons and an adolescence of many misapplications. In maturity, plastics must take their place as recognized engineering materials that will contribute more and more to the advance of our industrial civilization. It is in this forward march that PLASTICS TECHNOLOGY undertakes to play an important part.

•

We could not conclude this brief expression of our editorial philosophy without thanking those who have helped so enthusiastically in the production of this first issue—our contributors, the men of the industry who make up our Editorial Advisory Board, and our editorial staff. And being human, we shall be most happy to receive your comments—the brickbats as well as the bouquets—and your studied suggestions for making PLASTICS TECHNOLOGY progressively more useful to a vital and dynamic industry.

Arthur M. Merrill

Editor

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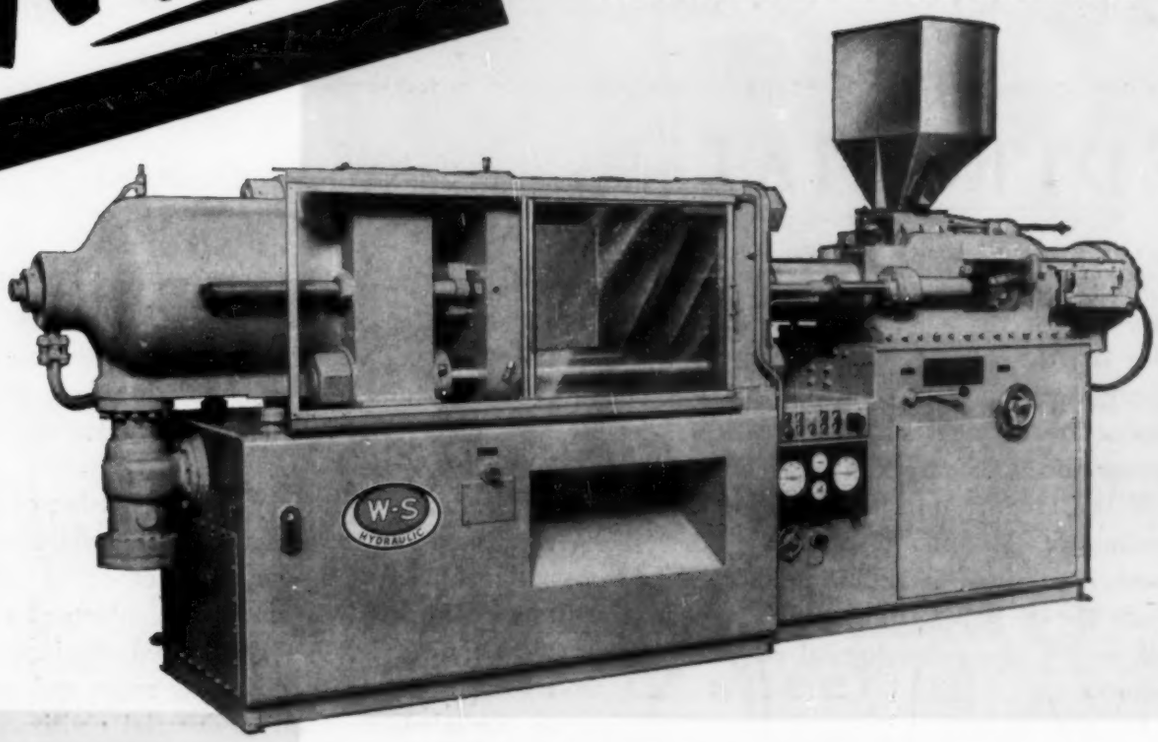

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New Fields to Conquer— The Future Outlook

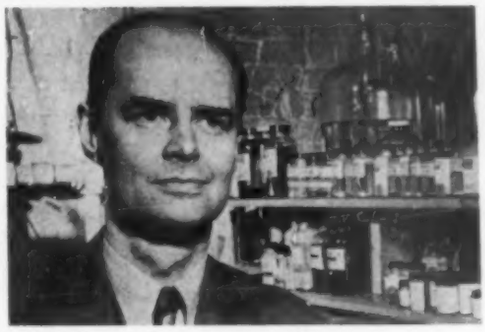
The outlook for continuing plastics expansion based on reductions in fabricating cycle time and material costs.

JOHAN BJORKSTEN, *President*
Bjorksten Research Laboratories, Inc.
Madison, Wisconsin

In its short span of existence, the plastics industry has grown by steps rather than continuously. Whenever a technical advance has brought a plastic beyond parity with an established material, the plastic has flowed into the field thus opened.

It may be of interest to glance forward, looking particularly for fields where an improvement in plastics quality or a reduction in costs should make possible new large expansions.

We have heard much of the sonic barrier and the thermal barrier. Similarly, there are two barriers in the way of further expansion of plastics: the time barrier, and the dollar barrier.



Dr. Johan Bjorksten was born in Finland, and studied at the University of Helsingfors. His published work in high polymer chemistry attracted the attention of the Rockefeller Foundation. He came to the United States in 1931 for post-doctoral work, then entered industry and was associated with Felton Chemical Co., Pepsodent Corp., Ditto, Inc., and Quaker Chemical Products Corp.

He founded Bjorksten Research Laboratories in 1944, and has been president and board chairman of the firm ever since. He was also a co-founder of ABC Packaging Machine Corp., of which he has been vice president since 1943, and Bee Chemical Co., of which he was president from 1944-1946. Dr. Bjorksten holds approximately 50 patents in the fields of plastics and organic chemicals.

THE TIME BARRIER

It is probably now recognized by everyone in the plastics molding industries that our most important task is to speed up fabrication operations. The plastic age will not truly have arrived until we can turn out plastic articles as fast as a metal stamping press knocks out stampings. The time barrier represents the limits imposed by present time cycles which are dependent, to a large extent, on time lags in heating or cooling.

A large new field of plastic fabrication will be opened when this barrier is broken. At present, plastics have a time advantage only in certain structures requiring multiple operations when made from metals. Passing the time barrier will generalize this advantage of plastics, and will greatly increase our sales field in all the mass production industries.

The fast curing phenolics and the pre-impregnated epoxy, polyester, or phenolic fabrics or mats are steps in this direction. They permit rapid forming, with the curing completed after the rapid press operation. Postformable reinforced thermoplastic sheets also hold promise. However, even by choosing a flexible weave in the reinforcing glass fabric, the lack of elasticity in glass will greatly limit the possible form changes by fast forming techniques on reinforced material. While 1:8 draws have been claimed, this forming is at best a difficult operation.

For such forming, other kinds of reinforcements are needed which can be drawn along with the blank, yet retain very high strength. Such types of reinforcements might be obtained by using fibers which on heating and subsequent rapid quenching become cold-drawable and remain so for some time. Examples of such fibers include undrawn or partly drawn polyvinylidene chloride

Standard Oil Company (N.J.)

Fig. 1. Sugar cane, a possible source of low-cost plastics? Sugar may well become the basis for low-cost resins of low hydrogen permeability for use in water handling.

or polyvinyl chloride, and probably also partly drawn polyamides.

If we have a sheet of drawable, fairly temperature-resistant plastic base in which such fibers are adhesively imbedded, the sheet could be passed through a heating zone to make the fibers cold drawable, and then quenched and stamped out on a stamping or forming press at speeds as high as those of metal stamping. By fabricating at room temperature on supercooled material, we would avoid the time lags due to heat transfers and, thus, be on a par with metal industry with regard to speeds of operation, without any need for further cure.

The dominating position of glass fibers as plastics reinforcements is due in large measure to the excellent technical service and brilliant promotion by the principal producer of glass fiber. This has led to an overshadowing of other fibers, which have not been properly worked as yet into the laminate picture by developing the necessary finishing and handling techniques.

We do not intend to imply that cotton, polyvinyl chloride, saran, nylon, dacron, orlon, and other fibers will displace glass fiber from its well-deserved position. Rather, these fibers, when properly treated and adapted, should open new fields of application for reinforced plastics where extreme strength may not be essential, but where formability and elasticity of the reinforcements are absolutely necessary for high-speed fabricating techniques.

THE DOLLAR BARRIER

The dollar barrier relates to the cost of plastic materials per pound or per cubic foot. Additional large markets will open, particularly in the structural fields, when plastics can match the costs of other standard structural materials on a weight or volume basis. This goal is quite possible of attainment, but will call for substantial improvements in current processes and techniques.

At least four paths are open toward drastic cost reductions in plastic materials:

(1) Improvements in fillers, making it possible to work in higher percentages of fillers and attain higher strengths than are currently available. In this regard, the plastics industry still has much to learn from the rubber industry.

(2) Improvements in production mechanics. Continuous production of plastics has been achieved in a few instances on a fairly moderate scale, but such applications must expand greatly as production grows.

(3) Improvements in the chemical techniques for making plastics, particularly toward the elimination of high pressure steps, and the shortening of time cycles.

(4) Introduction of altogether new plastics from low-cost raw materials.

Fillers

Much can be done by improving filler performance. For one example, a gas-phase treatment of powdered silicaceous filler with vinyl chlorosilane, followed by a hydrolytic treatment, should go far to improve the wettability of the filler and resultant strength of the

filled article, and to permit increasing the filler percentage.

In the case of oleophilic resins, consideration of the oil adsorbency properties of the pigments will aid in the selection of pigments which can be used in high percentages.

Where plastic articles are being produced continuously, filler performance and bond may well be greatly improved by feeding freshly powdered filler into the stream of plastic during processing, so that newly formed surfaces of filler particles are exposed to plastic before they have had time to adsorb moisture or gases from the atmosphere.

Continuous Production

Continuous production of polyglycol terephthalate fiber and film directly from the raw materials is already a reality. The further adoption of these techniques seems a certainty as soon as the tonnage has become sufficiently large to support the initial investment and to ensure steady operation. Polystyrene, polyvinyl chloride, and polyethylene are being made by continuous methods.

Steel firms are evincing interest in reinforced plastics. This may lead to the adaptation of the spectacular steel technology to the plastics industry.

Improvement in Chemical Techniques

The outstanding accomplishment of 1954 was the achievement of polyethylene synthesis at low and even atmospheric pressures. This should go very far toward making these resins available at a price bearing a direct relation to the low cost raw materials from which they are made. Polyethylene made by the low-pressure method has many similarities to rigid vinyls, and may contribute to a lowering of PVC prices which soon may be below polystyrene prices.

The use of extremely high vacuums and thin film techniques to speed condensation reactions should find application in many resin condensation reactions other than those for the manufacture of Mylar.

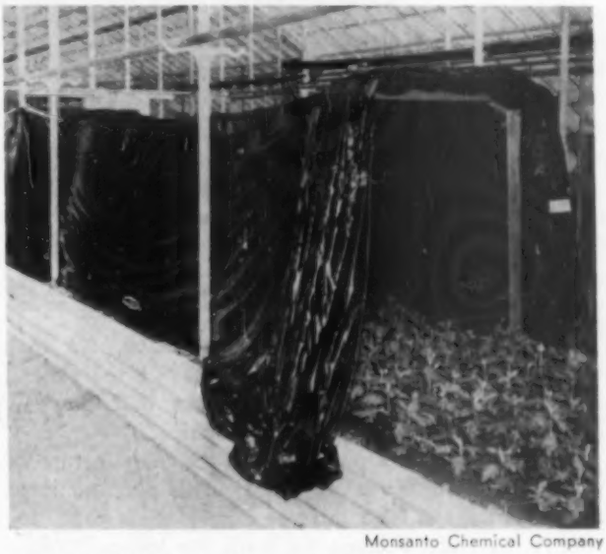
Improvements in manufacturing techniques for polyvinyl chloride are being embodied in at least one plant now being constructed abroad. While radiation techniques for polymerization have not yet arrived commercially, they cannot be discounted in cases where stability of the end-product can be best achieved by avoiding the use of polymerization catalysts. At the present time, however, the novelty of irradiation has led to publicity for the process out of proportion to its importance, since the economics are unfavorable for applications other than specialty objects.

New Plastics from Low Cost Materials

Potentially low-cost plastics are the reaction products of sulfur dioxide with unsaturated hydrocarbons, particularly butenes. At the present time these are too unstable to light and heat to be of practical use. However, we must not forget that the vinyl chlorides once were regarded as "hopelessly unstable." The advent of stabilizers and faster molding techniques

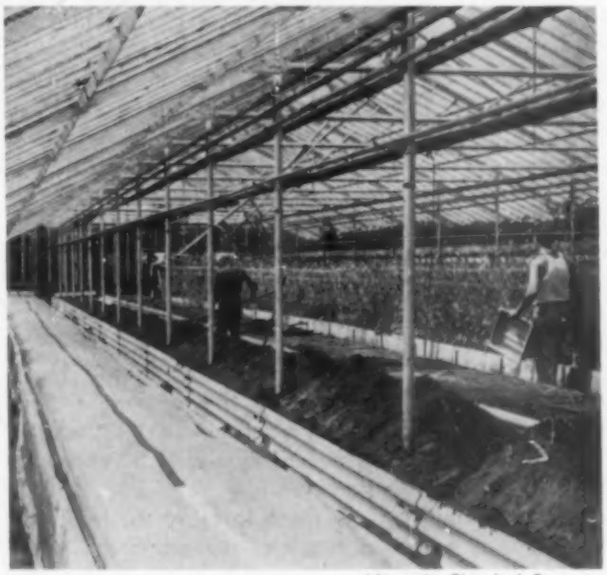
Monsanto Chemical Company

Fig. 2. Vinyl film tarpaulins being used as protective wrappings of idle machinery and equipment.



Monsanto Chemical Company

Fig. 3. Black vinyl film provides proper shading of young chrysanthemum plants in greenhouses.



Monsanto Chemical Company

Fig. 4. Vinyl film is used to seal in steam or fumigant during seed-bed sterilization in greenhouses.

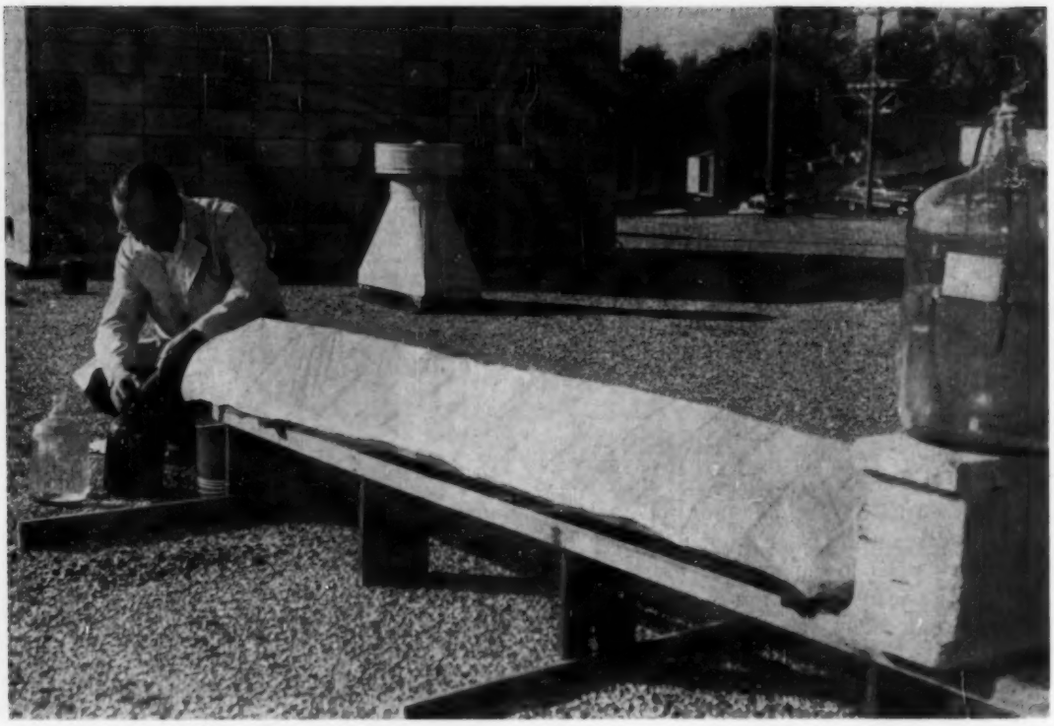


Fig. 5. Experimental solar-powered still to convert salt water to fresh water employs plastic film.

changed this and made the vinyl chlorides one of the most rapidly growing plastics.

When the sulfone resins are stabilized, we may have a new moldable thermoplastic having the general appearance of polystyrene at perhaps half the raw material cost of any present thermoplastic.

Another intriguing possibility, is the manufacture of plastics from sugar (see Figure 1). This polyfunctional raw material, available in large supply at six cents per pound, may well become the basis for low-cost resins of low hydrogen permeability for use in water handling and irrigation.

Large-scale transportation of water would require very considerable quantities of lightweight plastic tubing. A new approach might have some possibilities where water is to be moved over distances of several hundred miles, from sea level to high altitudes, or both.

In transporting water, why should we have to move the oxygen which is present everywhere in the atmosphere? Why not move just the hydrogen, and recombine it with the oxygen at the point of destination to regenerate the water?

The apparent advantages of such a procedure are:

(1) We would have to move only 11.1% of the equivalent water weight, thus saving much energy.
(2) We would have a practically weightless substance, so that no energy would be expended to overcome gravity.
(3) It would cost no more to move the hydrogen to a mountain top, and regenerate the water there, than it would cost to move it to a low location. Thus, it would be inexpensive to have terminal reservoirs at high altitudes to permit distribution of water by pressure, and make possible a hydroelectric energy gain.
(4) Combustion energy would be recovered at the endpoint where the hydrogen could be made to run hydrogen explosion motors or combustion turbines.
(5) Pipe line friction would be minimized, thus saving pumping costs.
(6) Pipelines could be laid very rapidly and, probably, at great savings in costs.

The apparent disadvantages are as follows:

(1) The cost of electrolysis is high. This will be compensated for in part or in whole by the sale of chlorine; power gained from the combustion of hydrogen at the terminal point; and hydroelectric power derived by running water down from high altitudes.
(2) The hydrogen tube represents a fire hazard.
(3) The hydrogen tube is vulnerable to mechanical damage.
(4) Efficient cooling at the terminal is necessary to condense the water.

Under certain conditions the advantages may outweigh the disadvantages. From the standpoint of plastics industry, this is to be hoped for since the potential market is significant.

APPLICATION OF PLASTICS

Plastic Film

Plastic films have only begun to touch the agricultural and structural fields. Here, expansion has already started toward the large volume applications of silo covers, tarpaulins (see Figure 2), freight car liners, snow covers, greenhouse glazing and shading (see Figure 3),

shading to control maturation time of crops, soil sterilization (see Figure 4), and roofing. The protection of underground structures against water seepage is another interesting possibility.

General adoption of underground construction in an era of atomic uncertainty, might prove a great boon to the film industry, as positive water protection of underground structures is best realized by "wrapping" them in plastic film. Here, we have two competing trends; the extreme high strength bi-dimensionally oriented film exemplified by Mylar, and the reinforced laminated film now beginning to make its appearance.

Devices based on plastic film for conversion of salt water to fresh water have been recently discussed and, therefore, are only briefly mentioned here. This development alone could multiply the current requirements for plastic films. An experimental solar powered salt water still is shown in Figure 5.

High Temperature Applications

In discussing new fields of applications for plastics, we should mention the great importance of extension toward higher temperature areas. Our entire industrial technology is moving toward operation at higher temperatures. In all types of electrically operated devices, higher temperature tolerances permit the same quantity of energy to be handled in smaller and less costly equipment. In all devices operating at high speed, including airplanes, any increase in the temperature stability of component plastics parts is immediately translated into higher speeds and efficiencies.

A great deal of effort is being directed into extending the temperature range of plastics with silicones, fluoro derivatives, and other approaches under consideration. This area is in a state of flux with little being published as yet.

Surface Treatments

Simplification of production can be accomplished by the more general use of surface treatments and coatings. This reduces the need for different colored stocks, and cuts down the percentage of seconds. Equally important, particularly for larger pieces, it offers opportunities for quality improvement which have hardly been tapped.

In the metal industries, it is a well established practice to apply treatments which will harden the surface, leaving the inner parts of the article resilient for higher tenacity and impact strength. With the exception of some of the Logoquant treatments, hardly anything has been done in plastics along this line. It is expected that the engineering range of present plastics will be extended appreciably by working with high impact materials as the cores, and then obtaining the required surface hardness and resistance by appropriate coatings or treatments.

NON-DESTRUCTIVE TESTS

When glass-reinforced plastics exceeded steel in strength-to-weight ratio, the stage was set for expansion of the plastics into the structural field. This expansion is taking place in an orderly fashion, but is handicapped by the lack of adequate engineering data on the properties of the laminates and, in particular, by the lack of practical means for non-destructive methods for inspection.

It is possible, and sometimes even easy, to find gross defects, cavities, or complete lack of adhesion in laminates by X-rays, dielectric measurements, transducers, thermography, and sonic or ultrasonic reflection or vibration measurements. However, we do not yet have any dependable means for determining, without destruction, whether the flexural strength of a laminate, such as a boat hull, is 20,000 or 90,000 psi. at a certain point.

The greatest single contribution that could be made today to the field of reinforced plastics would be the invention of a device which, without destruction, could determine the strength properties of a reinforced sheet

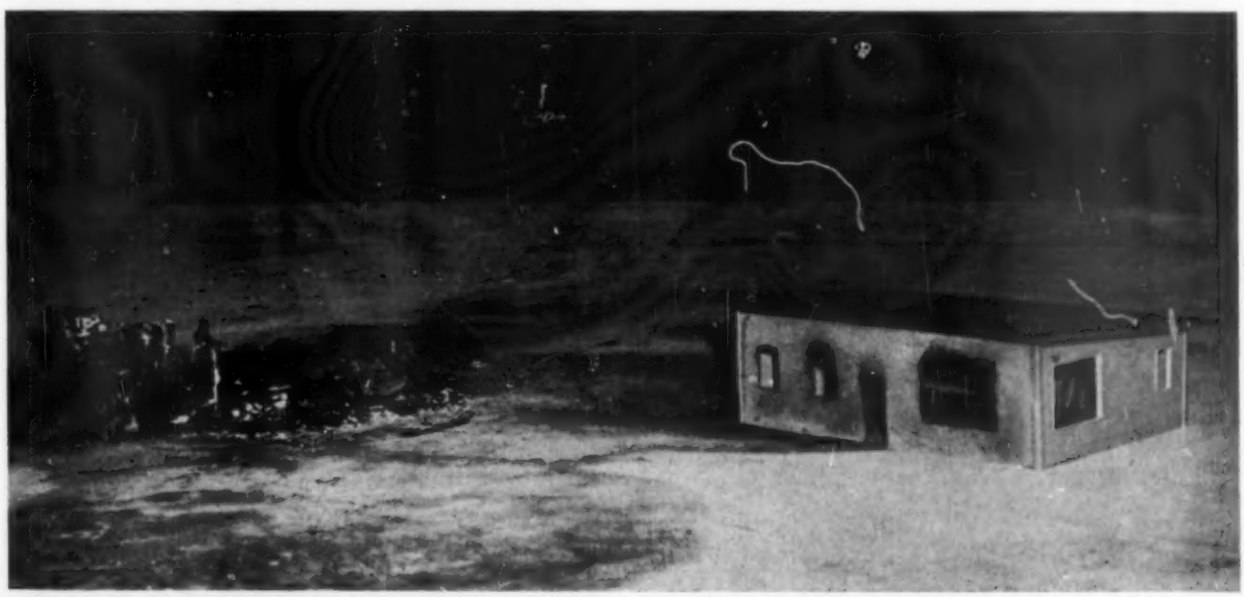


Fig. 6. Fire-resistant properties of Hetron type endochloro polyester resin are demonstrated by small model houses of wood (left) and Hetron (right) which were wet with gasoline and then ignited. As is apparent, the wood model burned down completely, while the Hetron model is only mildly scorched and still suitable for further service.

quickly, precisely, and quantitatively.

Should it prove impossible to develop such a non-destructive testing device, the alternative path would be to apply such testing to the component parts or ingredients, and such controls during manufacture that would assure the production of consistent high strength articles.

This may mean a better standardization of the glass fiber sizing, and probable application of the vinyl silane in gas phase or at the fiber forming bushing so that there can be no question as to the uniform and complete sizing of the reinforcement. For mass production articles and continuous laminates, we shall undoubtedly come to a high degree of integration of the industry. By producing the resins in the plant where they are to be used, or by working out tank car or pipeline connections to assure a minimum of delay in transit, it will be possible to reduce the amount of inhibitor required, and to improve uniformity and control in all respects.

When a quick, non-destructive testing method has been found and adequate engineering data have been gathered, we shall see a rapid expansion of reinforced plastics in the field of primary structures. The low modulus property, which is now a limitation, will be made to serve a useful purpose by skillful design. Where this is not possible, adequate rigidity can be achieved by the use of honeycomb and foam sandwich structures.

The advent of fire resistant Hetron type endochloro polyester resins overcomes a principal remaining obstacle to the adoption of glass reinforced plastics for large scale building applications. This fire resistance property is demonstrated in Figure 6. An engineering data comparison of Hetron resins with steel, wood, and concrete is given below by indicating the weight of a laterally-supported 20-foot beam able to support 800 pound/linear foot static load. The weight of this beam, when made of the different materials, is as follows: concrete, 4,180 pounds; wood, 644 pounds; steel, 500 pounds; glass-reinforced endochloro type polyester with 60% glass cloth, 127 pounds.

Extrusion of plastics in definite engineering shapes was reported in 1953. Much work remains to be done in adapting these shapes to the characteristics of plastics before such time as engineering practice and experience catch up with the present state of materials development in reinforced plastics, so that progress can be speeded on a united front.

FOAM DEVELOPMENT

It is always attractive to sell gas by volume, and this is what the foam business does. However, when the gas is actually made to serve as a solid, this business is to the advantage of both the public and the manufacturer. Combined with plastisol slush molding techniques, or fabricated by simply filling plastic or textile bags with foam, the foams make possible a whole series of household and utility articles.

Not yet in practical use is the possibility of foaming paints and adhesives for resilience and insulation. Building insulation which can be sprayed to adhere to walls and then foamed in place is still stymied by practical difficulties, mainly in achieving the necessary uniformity over a wide temperature range. These difficulties are being gradually overcome. In the maritime industry, filling unused space with foam will make ships and boats unsinkable.

A more intriguing speculation is whether it will be possible to make a flying foam by dispersing hydrogen or helium into a plastic, or by otherwise releasing hydrogen in such a plastic. Di-isocyanate may be used here for cross-linking to give the necessary resilience, but not for foaming in this case, since a buoyant gas is needed.

A flying foam might intrude on us in new forms of advertising for the aerial highways; it may amuse our children as new toys; but it could also serve major purposes, such as reviving the lighter-than-air airship.

It does not seem likely that the flying foams could find use in agriculture in the foreseeable future, though the thought would be alluring to send a garden skyward, have it float as a cloud above the level of insects and pests, and finally return to the ground by gravity when the crops have reached a certain weight.

Molded Acrylic Prism

Used In New Outdoor Sign

Rotating acrylic prisms made by injection molding form the basis of a new and spectacular illuminated outdoor advertising display by Cadillac Motor Car Division, General Motors Corp., in San Francisco, Calif. Invented by Rudy Pabst of Prism Sign Co., San Mateo, Calif., the prismatic effect is used in an 8 by 15-foot royal blue field to illustrate the familiar Cadillac "V" and crest as part of the over-all, 27 by 60-foot sign.

The prismatic effect is obtained by the use of 40,000 acrylic prisms stacked on 49 rotating columns driven through nylon gears. Separate illumination for the area is furnished by 320 fifty-watt incandescent lamps, each with a 16-facet reflector.

Since the prismatic area has separate illumination, it can be lighted during the day, as well as at night; a novel effect in outdoor displays.

The sign also features red plastic-faced script letters spelling out "Cadillac" along a 31-foot length. The letters are almost seven feet high, and are lighted indirectly from within.

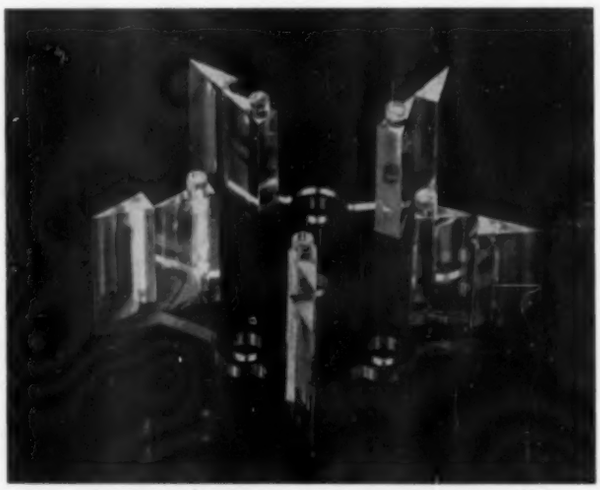


Fig. 1. Individual injection molded acrylic prism wheels are 3 9/16-inch wide and 1⅛-inch high.

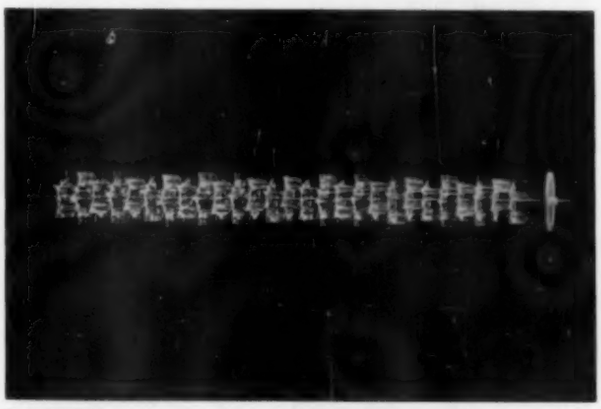


Fig. 2. Prism rotor consists of prism wheels assembled on 3/16-inch steel rod mounted in injection molded nylon gear.

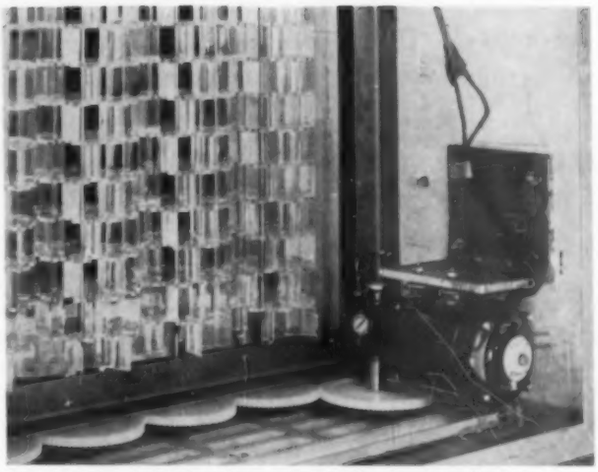


Fig. 3. Rear view of rotor assembly shows method of mounting and driving rotors. Rotor shafts run in nylon bushings.

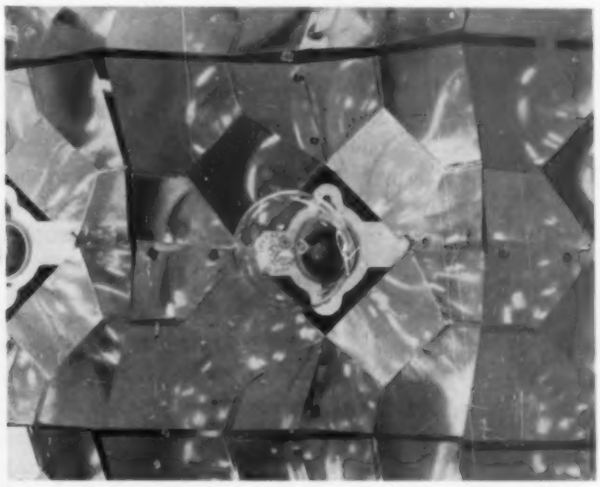


Fig. 4. Close-up of reflector unit shows facets and opening near base of lamp for ventilation.

Fig. 5. Night view of sign with illuminated prismatic field at upper left which gives a sparkling effect.

Plastic Tooling for Plastic Parts*

Advantages, Disadvantages, Manufacturing Methods, and Applications of Plastic Tools for Use in Molding or Forming Plastic Parts.

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While the development of plastic tools for metal forming operations has recently received considerable publicity, the application of plastic materials for plastics tooling has been relatively ignored. Plastics have been and are being used as tooling materials in the plastics industry. Plastic tools have been built and used successfully in a variety of plastic molding and forming operations including forming of fiberglass reinforced plastics, vacuum and stretch forming of sheet thermoplastics, slush molding of vinyls and related polymers, post forming and casting of phenolics, etc.

The reinforced plastics industry, in particular, has pioneered the application of polymeric materials for the production of tools, and developed many of the techniques later adopted by other branches of the plastics industry. The subsequent discussion will be primarily concerned with the selection of plastic materials and construction of plastic tools for fiberglass reinforced plastics, although other applications will be mentioned.

The field of plastic tooling offers many more promising applications for the production of plastic parts than have hitherto been considered. This field is still in its formative stages and many changes in both materials and techniques can be expected. A steadily increasing amount of experimental work is contributing towards the solution of the constantly arising technical and economic problems.

This topic can conveniently be broken down in three questions: (1) Why should plastic tools be used?; (2) When should they be used?; and (3) How are they made? Since these questions cannot be answered fully unless due attention is given to the limitations of plastic tooling materials, both the undesirable as well as attractive features of plastic tools will be discussed.

Why Plastic Tools?

Proper application and construction of tool plastics result in substantial cost reductions in both manufacturing costs and tooling time. Other equally important yet less obvious advantages include the following:

(1) Simplicity in manufacture. Lower tool room equipment investment, use of unskilled and semi-skilled labor, and the elimination of many grinding and polishing operations all combine to yield lower manufacturing costs.

(2) Ease of repair and alterations. Plastic tools can be repaired and/or altered with a minimum of labor and equipment. This is in sharp contrast to the expensive operations required for the repair of metal tools where, in addition, many types of alterations are unfeasible because of cost considerations.

(3) Greater freedom of design. One of the potentially most significant advantages of plastic tooling is that it frees the product designer from the traditional limitations of metal design. Intricate shapes and compound curves can be produced at costs hereto considered prohibitive because of expensive metal forming operations (see Figure 1). Plastic tools for the first time permit true functional design free from the artificial framework of the few economically feasible metal forming processes.

(4) Economic small production runs. The acceptance by tool fabricators of orders for trial lots and small production runs (less than 500-1,000 pieces) is made possible by the economic advantages of plastic tools over conventional metal dies. This opens up an entirely new area of activity for plastics fabricators, since small production runs can now be made at minimum tooling expense. This permits better gaging of market reaction, as well as any desirable alterations in product design indicated by the market reaction. This latter feature is of special significance in these days of increasing competition when emphasis is sharply focused on product styling and style changes.

A plastic part can be no better than the tool from which it was produced. It is, therefore, a fundamental consideration that any tool by its

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Eugene Singer

* Based on a paper presented before the Reinforced Plastics Group of the New York Section, Society of Plastics Engineers, Inc., Sept. 29, 1954.

TABLE 1. PROCESSING DATA FOR PLASTIC TOOLING COMPOUNDS

		Epoxy		Polyester	
	Phenolic Casting	Aluminum Casting	Laminate	Casting	Laminate
Commercial availability	Two-component system consisting of liquid resin and hardeners	Two- and three-component systems consisting of liquid resin and liquid and/or solid hardeners	Two-component system consisting of liquid resin and hardener; fiberglass reinforcements used	Three-component system consisting of liquid resin, hardener, and accelerator	Three-component system consisting of liquid resin, hardener, and accelerator; fiberglass reinforcements used.
Hardener or catalyst content (based on resin weight), %	8-20	6-24	6-10	0.5-2.0	1.0-3.0
Accelerator content (based on resin weight), %	—	—	—	0.1-2.0	0.1-2.0
Ease of mining	Good	Fair	Excellent	Good	Good
Ease of pouring	Good	Fair	—	Good	—
Ease of wetting	—	—	Excellent	—	Good to Excellent
Pot Life at 75° F.	1-2 hrs.	10 min. to 4 hrs.	10 min. to 27 days	10 min. to 24 hrs.	10 min. to 2 weeks
Room temperature curing	Yes	Yes	Yes	Yes	Yes
Time, hrs.	12-60	0.5-8.0	0.5-8.0	0.5-24	0.5-24
Elevated temperature curing	Yes	Yes	Yes	Yes	Yes
Temperature, °F.	120-150	120-350	150-250	150-250	150-250
Time, hrs.	6-24	2-4	1-4	0.5-24	0.5-12

TABLE 2. PHYSICAL PROPERTIES OF PLASTIC TOOLING COMPOUNDS

		Epoxy		Polyester	
	Phenolic Casting	Aluminum Casting	Laminate	Casting	Laminate
Density, lbs./cu. ft.	79	115	110	78	195
Barcol hardness	—	60	70	55	70
Flexural strength, psi.	8,000	15,600	45,000	14,000	45,000
Compressive strength, psi.	11,000	19,500	42,000	22,000	45,000
Tensile strength, psi.	5,000	10,000	30,000	8,000	33,000
Impact strength (notched Izod), ft. lbs./in.	0.25-0.30	1.0	15-20	0.25	15
Water absorption, %	0.4	0.5	0.6	0.25	0.3
Shrinkage from mold dimensions, %	Negligible	0.2	Negligible	8.7	Negligible
Machinability	Good	Excellent	Fair	Good	Fair
Heat resistance	Good	Fair	Poor	Fair to Excellent	Fair to Excellent
Linear coefficient of thermal expansion, in./°F. x 10^{-5}	0.62	6.3	1.5	5	1.2

Fig. 1. Mating parts of glass-reinforced cast phenolic tool illustrate design possibilities that are economically unfeasible with metal tools. The tool is used to manufacture reinforced polyester plastic ducts.

very nature must be constructed precisely in order to realize maximum fidelity of reproduction in the parts. The manufacture of accurate dies or molds with closely held dimensional tolerances still requires the services of craftsmen familiar with the techniques of the pattern maker.

A common and unfortunately much publicized misconception has developed to the effect that plastic tools somehow require less care and attention during construction than their metal counterparts. Plastic tools require just as much skill during manufacture as do conventional metal ones, but the emphasis is placed on a different phase of construction. In both cases unskilled help, adequately supervised, suffices for much of the manual labor. In the production of plastic tooling, however, the mold preparation prior to pouring or laminating the plastic tooling compound requires the same degree of skill and care that is needed for conventional metal tools after casting (i.e., barbering, machining, and polishing).

Experience indicates that the advantages of plastic tooling over conventional metal dies increase directly with the size and complexity of the parts to be produced. Maximum benefits are realized with large intricately shaped and contoured tools whose cost would be prohibitive in metal, especially for short runs. Plastic tooling for the plastics industry also need not be limited to the fabrication of plastic parts. In most cases, drill and checking fixtures, holding jigs, assembly forms, and many other special tools are needed to complete the fabrication of a molded plastic part, and most are amenable to production with plastic tooling compounds.

Fiberglass reinforced plastics fabricators are in a unique position in the plastics industry with regard to the utilization of plastic tools. The limited pressure requirements as well as the small production runs on many fiberglass reinforced plastic parts lend themselves advantageously to plastic tooling, especially with polyesters, epoxies, and other solvent-free polymers.

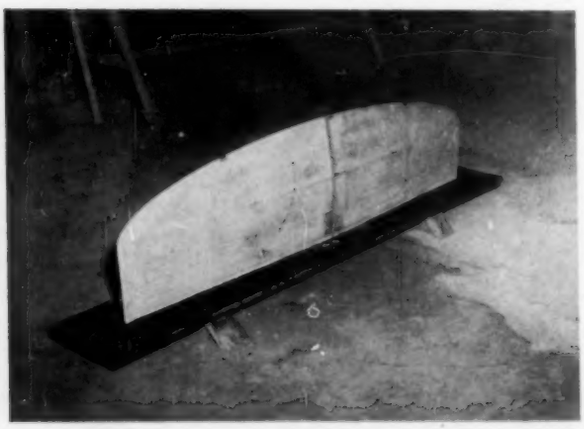

Fig. 2. Cast phenolic die for vacuum bag molding of reinforced polyester part for helicopter stabilizer. Additional material was inserted between cut halves of the die to bring size up to revised specifications.

WHEN SHOULD PLASTIC TOOLS BE USED?

Plastic tools should be selected for a given job by using the same considerations applied to conventional tool materials. The choice of a plastic tool is indicated only when some significant advantage can result from its use. If no advantage results, it should not be used. It is necessary, therefore, to clearly understand the properties and applications methods for plastic tool materials in order to arrive at a sound decision.

Plastic tools can be made of a number of resins whose choice is dependent on the type of tool, dimensional accuracy required, wear conditions, operating temperatures, expected tool life, cost per pound, etc. The physical strength properties of the resins may play a decisive part in material selection for a given tooling problem.

The most commonly utilized plastic tooling compounds fall in one of three chemical classes: phenol formaldehyde resins; polyesters; and epoxies. For all practical purposes these materials are used for tooling in one of the following forms: (1) phenolic casting compounds (see Figure 2); (2) epoxy casting compounds (see Figure 3); (3) epoxy laminates, usually with fiberglass cloth reinforcements; and (4) polyester laminates, usually with fiberglass cloth reinforcements. Polyester casting compounds are seldom employed for plastic tooling work on account of their poor dimensional characteristics.

All these plastic tooling materials have certain characteristics in common. Furnished as liquids with widely varying viscosities, they can be converted into hard, strong solids by the application of chemicals (catalysts, accelerators, etc.) and/or heat, with or without suitable inorganic reinforcements such an mineral and fibrous fillers, but generally without pressure. Chemical reactions involved in this conversion build up a considerable quantity of heat within these materials, especially in thick sections, on account of the thermal insulating characteristics of plastics. Properly selected mineral and fibrous reinforcements are essential in order to realize universally usable materials.

Phenolic resins at less than $.50 per pound are generally less expensive to use than polyesters ($0.30-$0.35 per pound) in combination with glass reinforcements ($0.40-$2.00 per pound), or epoxies ($0.90-$3.00 per pound). Raw material price is, of course, only one of the considerations entering into the selection of a plastic tooling compound.

The processing characteristics of plastic tooling compounds are given in Table 1. Specific data vary, of course, with the formulation employed.

Plastics for plastic tooling work exhibit the general physical properties listed in Table 2.

The data presented in Tables 1 and 2 should be of some help in the selection of plastic tooling materials. Obviously, the plastics fabricator should choose that material with the required physicals which can be most economically converted into a useful tool with his equipment. Material selection, therefore, depends on the physical facilities of the fabricator; i.e., oven availability, etc. While this does not narrow the availability range for most fiberglass reinforced plastics molders, people engaged in vacuum forming, sheet fabrication, and the like are often limited to room temperature curing systems.

Another consideration which may restrict the choice of a tooling compound is the heat and chemical resistance of the master model. Model materials such as clays, waxes, wood, etc., can successfully withstand elevated temperatures only within a narrow range and for a limited period of time. Tooling compound selection must take cognizance of this most elementary and only too often neglected fact.

In all cases where tooling compounds are purchased from a formulator, processing recommendations should be adhered to strictly if optimum results are desired. Since no part can be better than the die from which it was produced, this applies particularly to the preparation of the master model prior to tool production.

COMPARISON OF COMMON PLASTIC TOOLING MATERIALS

Phenolic casting compounds are inexpensive, require only moderate cure temperatures, and are relatively foolproof in handling and processing. Both cast and laminated epoxies require considerable skill in formulation, handling and processing to get acceptable results. Cure conditions are critical with epoxies, and close control must be exercised on both cure temperatures and times. The primary advantages of epoxies over phenolics are their strength and toughness in contrast to the inherent brittleness of phenolics.

Laminated tools in general have greatly improved impact strength when compared with rigid type castings. Polyester and epoxy laminates exhibit similar physical strength properties, although epoxies generally possess greater inter-laminar bond strength as a result of better wetting (i.e., the resin impregnates the glass fiber reinforcements more quickly and more thoroughly). The heat resistance of epoxies, however, is generally inferior to that of polyesters, and their initially superior strength falls off quite rapidly as the temperature rises.

Phenolic resins have been used quite extensively for tool work. One estimate for 1954 consumption in this field is 3,000,000 pounds. Introduced barely 18 months ago, epoxies are rapidly gaining a dominant position in this field. Superior physical and chemical properties tend to offset their higher price for many applications. Over 2,000,000 pounds of epoxies will be used for various tooling work in 1954, and a four-fold increase of this figure is predicted by 1956. Polyesters are generally used as laminated tools, and do not represent a major factor at this time. Furane type polymers are, perhaps, the most promising of the new tool plastics under development.

DISADVANTAGES OF TOOLING COMPOUNDS

The principal disadvantages associated with the use of plastic tooling arise from the relatively poor heat resistance of synthetics when compared to conventional metallic die materials. These disadvantages include low heat distortion temperatures, high coefficients of thermal expansion, poor thermal conductivity, and limited resistance to thermal cycling especially under load. The net result of these varied thermal characteristics is the development of stresses and strains which become sufficiently serious to produce either excessive distortion in the shape of the tool, or cracks which result in structural failure. The maximum safe service temperature of plastic tools at this time is generally well below 200° F. Pressures should not exceed 100 psi., especially at elevated temperature. Wear resistance is unfavorably affected by elevated temperature service, especially when in excess of 200° F.

While a considerable amount of experimental work is being carried on to minimize or eliminate these shortcomings, tool applications in fiberglass reinforced plastics for plastic tooling compounds should be limited at this time to either hand lay-up or bag-type molding operations. Some interesting results have been obtained experimentally with matched plastic dies in press operations. However, these results are too scanty and erratic to warrant consideration of plastic tools for press work at this time.

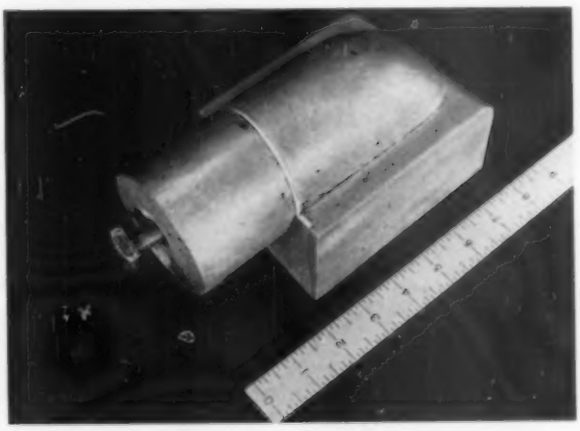

Fig. 3. Cast aluminum epoxy tool. Inaccurate metal tool originally made for this application would have required about three weeks for corrective machining. This epoxy tool was cast in eight hours.

FIGURE 4

Manufacturing operations for making a laminated phenolic tool by hand lay-up method. This tool was then used to make a glass-reinforced polyester plastic part. The sequence of operations is shown in the pictures:

Fig. 4 (A). Glass cloth lay-up for tool being coated with phenolic resin;

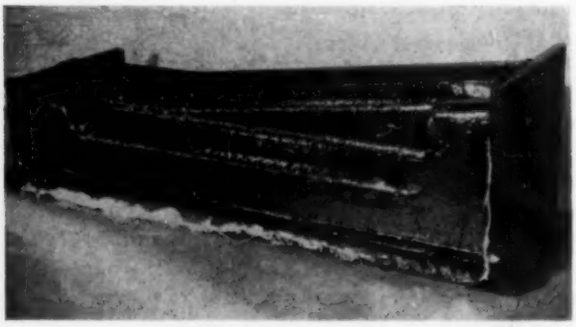

Fig. 4 (B). Completed tool lay-up after coating with resin;

Fig. 4 (C). Assembly of split tool after curing;

Within the above-stated pressure and temperature limits plastic tools can give satisfactory service in fiberglass reinforced plastics for a considerable period of time. Suitable mold release agents or lubricants are available for parting finished moldings from plastic tools. In general, film-type separators are to be preferred over oils and waxes primarily on account of the surface characteristics of plastic tool materials. Film-type separators are also employed effectively for the preparation of non-metallic master models prior to laminating or casting the plastic tool material against the model surface. Useful film-type lubricants include Kotol (Naugatuck Chemical Div., U. S. Rubber Co.), Hi-Glow (Western States Lacquer Company), and cellulose acetate coatings.

Another important consideration involves inserts. Considerable care must be exercised in both insert design and material selection. This is particularly true with tools subjected to elevated temperatures where there may be possible differences in the expansion rates and thermal coefficients of the inserts and the plastic tool materials.

MAKING LAMINATED PLASTIC TOOLS

Plastic tools are made by using either laminating or casting techniques. The former method utilizes glass reinforcements usually in the form of cloth. A typical cloth reinforcement for laminating operations is 1000 glass cloth or equivalent.

The production and use of a laminated phenolic tool is shown in the sequence of photographs in Figure 4. The construction of a laminated tool involves the impregnation of carefully patterned cloth strips with a

Fig. 4 (D). Split laminated phenolic tool ready for use;

plastic tooling compound followed by placement of the impregnated cloth layers onto the model. Enough layers are laid on the contours to be reproduced to obtain the desired tool thickness. Laminated assemblies are cured at either room or elevated temperatures in strict accordance with the formulator's recommendations. Use of a mold release agent is required to obtain easy separation of the laminated tool from the master model.

Construction of laminated tools places a premium on careful workmanship for realization of optimum results. Care must be taken to prevent the inclusion of air during the lay-up, especially when the tool is to be subjected to elevated temperatures. The presence of voids in the laminated tool can be the cause of failure at higher service temperatures due to expanding gas. Exotherm during cure is not a major problem with laminated tools.

The strength of a laminated tool varies directly with the degree of wetting of the glass fibers; i.e., the impregnation of the glass with the tooling resin. Medium or low viscosity resins generally penetrate and wet glass weaves easier than do higher viscosity materials. Open-mesh glass fabrics, such as the 1000 type previously mentioned, aid penetration. One indication of proper wetting with clear resins is the appearance of air bubbles on the working surface. Brushes, honeycombs, and other mechanical aids are commonly employed during laminating. Epoxy type resins generally give best wetting and impregnation with glass reinforcements.

Run-off on vertical surfaces can be controlled by the use of special thixotropic tooling formulations. Such compositions can be either purchased from reliable formulators or made easily by the fabricator using various readily available thickening agents such as silica aerogels, and others.

MAKING CAST PLASTIC TOOLS

One of the most important steps in the production of cast plastic tools, as with all other materials, is the preparation of the master model surface prior to pouring. Porous surfaces must be sealed as well as lubricated in order to assure proper parting of the cast tool. Film-type separators are generally more effective with non-metallic tools than are straight oils and waxes. Typical separators have been noted previously.

The major problem associated with the production of cast tools, especially epoxies, is the dissipation of exotherm during cure. The amount of heat developed depends on the size, weight, and shape of the part, with maximum heat build-up occurring in thick sections (two inches or more). Excessive heat development produces strains and stresses during gelation which may be serious enough to fracture the casting.

It should be remembered that two opposite phenomena occur during gelation: (1) shrinkage from the liquid resin to the solid state; and (2) the exotherm-initiated thermal expansion. Filled resins are generally more desirable than unfilled materials because the fillers help absorb some of the exotherm heat. Formulation of suitable casting compounds is a problem which is best not handled by the average fiberglass reinforced plastics fabricator, but left to formulators with greater experience in the field.

Phenolic casting resins have been developed where exotherm problems during cure have been largely overcome. Thick sections (over five inches) of these materials can be cast without fear of fracture. Experimental work in epoxy-phenolic formulations is now under way by both raw materials suppliers and competent formulators in an effort to produce a material featuring the advantages of both components.

Pouring and curing operations should be performed in strict accordance with the resin manufacturer's recommendations. Seemingly minor changes may greatly affect such factors as shrinkage and dimensional stability. Where resistance to elevated temperatures is required, curing at maximum possible temperature is generally

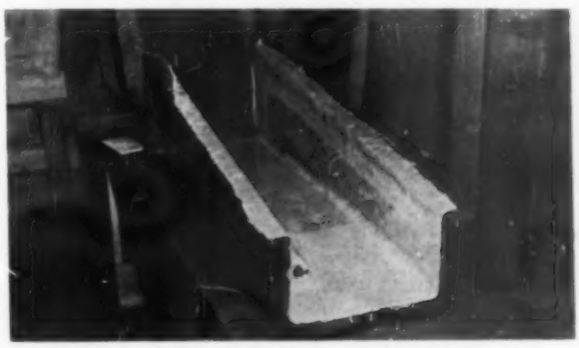

Fig. 4 (E). Lay-up of glass-polyester part against tool;

Fig. 4 (F). Checking, routing, and drilling fixture made of glass-epoxy laminate positioned on polyester part;

Fig. 4 (G). Finished glass-reinforced polyester part.

desirable for optimum thermal characteristics. Care should also be taken to effect thorough mixing of the various components involved in a tooling formulation in order to obtain uniform reproducible results.

SUMMARY AND CONCLUSIONS

Plastic tools can fill an important place in the plastics industry by making possible economic small production runs and permitting greater freedom in both tool and product design. Other advantages include process simplicity, and ease of tool repair and alterations. A variety of tooling materials have been developed for the manufacturer of both cast and laminated tools. The principal disadvantages of these plastic tooling materials arise from their poor thermal stability.

In the reinforced plastics industry the use of plastic tools is presently limited to applications where service conditions are less than 200° F. and 100 psi. pressure; i.e., hand lay-up and bag molding work. Experimental tools have been built for use in press molding operations, but results obtained to date do no warrant general adoption of this application.

Considerable improvements in the properties of tooling materials, especially epoxies, may be expected in the near future. These improvements should greatly enhance the use range of synthetics for tooling.

Guest Editorial

Cooperation Between Suppliers

A. L. HESTON, *Vice President*

National Rubber Machinery Co., Akron, Ohio

Close cooperation between material suppliers and machinery suppliers in application engineering on the new materials, as they were made available by their suppliers, has made it possible to provide the industry with machines adaptable to the various materials in their many forms.

As an example, the two-stage and the vented types of extruders today available to the industry make it possible to handle powdered, pelletted, or granular materials without pre-drying, and yet produce clear extrusions in the form of rods, film, tubes, or sheet.

When, over fifteen years ago, National Rubber Machinery Co., built the first extruders for the then existing thermoplastic materials, they were modifications of rubber extruders, except that provisions were made for supplying heat to the screws and cylinder jackets rather than for cooling them to remove and dissipate heat.

Over the years many new materials with new extrusion characteristics have been introduced, so that the machinery manufacturer has had a continual development program.

While the present-day extruder for thermoplastics is far superior to the designs used in the late 1930's, the improvements lie not alone in increased capacity, but also in precision performance. During recent years, substantial increases in power and heating requirements have become necessary as well as radically increased slenderness ratios (diameter versus length) of cylinders and screws.

Without the extrusion laboratory equipped with various types of extrusion machines and many combinations of cylinders, extensions, liners, screws, and dies, progress in extruding these new materials would have been slow and painstaking. At National Rubber Machinery, with a fully equipped extrusion laboratory, it has been possible to keep abreast of the rapid development of new materials. However, a machinery supplier alone can proceed only so far with the development of new ideas in the designing and building of equipment. The assistance of the materials supplier, and the actual testing of the combinations of new materials on new and refined types of machines are necessary for real progress. In addition to the contributions by materials suppliers, credit should be given to the fabricators (customers), and the instrument and controller suppliers for solutions to development problems not directly within the field of machine design.

Recent trends from oil heated to electrically heated extruders, with balanced control of temperature in all zones, have resulted largely from demands of customers. These demands have been met substantially by the materials suppliers working closely with the machine suppliers, with the result that the formulation of new materials and the creation of required extruder characteristics have been brought forward concurrently.

One of the latest advances is in greatly increased extruder capacity. For example, the latest designed 2½-inch extruder is now matching the production of the older 3½-inch machine. Likewise, the materials suppliers have shown the need for various refinements in dies, accessories, and even screw design, the latter being often the all-important factor. With the customer demand and with an understanding of new requirements in extruders, the machinery manufacturers have steadily improved their entire lines, while at the same time adding such new equipment as pipe haul-off units, sheeting take-offs, cutters and stackers, and continuous sheet extrusion and vacuum forming units.

Cam Actions for Injection Molds

The growing complexity of molded parts is placing even greater emphasis on cam action injection molds

WILLIAM LEWI, *Vice President*
Dusal Tool & Mold Co., Inc., Long Island City, N. Y.

Cam actions provide a means of moving any part of an injection mold that forms a definite undercut in relation to the direction of knock-out, and make certain that this movement occurs in proper relation to the knock-out movement of the molded parts. The growing complexity of molded parts and the need for eliminating as much secondary labor as possible are placing ever greater emphasis on cam action injection molds.

MOLD DESIGN FOR CAM ACTION

Before going into the various types of cam action, I would like to describe some of the basic design problems that we have encountered in our experience with the design and building of cam action molds.

The first and most important point is to try to design the part so that the mold can be built without any cam action. Cam action design means that the mold will require more and closer fitting parts. These parts require greater care in manufacture, assembly, and actual mold operation. This, in turn, means that the mold will cost more to build and its maintenance will be costlier and more time consuming. It must be remembered that the cams will move twice as often as the mold opening movement, thereby doubling the wear and providing a potential trouble spot.

If a cam action is necessary, careful consideration should be given to the question of how it will be built into the mold. Will it be a single-cavity mold with more than one cam? Do you have a group of cavities of which only a few require cam action? Whatever the requirements, all cams should be placed at or near the outside of the mold so that, in the event of mold flashing or other difficulty, the cam can be removed or replaced without taking apart the mold completely. Multiple cams should be located so that they balance out in the mold to reduce wear on the leader pins and other moving parts.

When a group of cavities require similar cams, the cams should not be put on the same action. Putting more than one cam on the same action may save money in the original tool cost, but a breakdown of one cam or the actuating mechanism will mean mold down-time and higher repair costs. When each cavity has its own cam action and one cam is damaged, the damaged cam can be removed and the mold continued in operation with only slightly reduced production while the repair is being made.

Our experience has also shown the importance of standardizing cam action design. Detailed prints should be kept on all cam actions, tolerances should be estab-

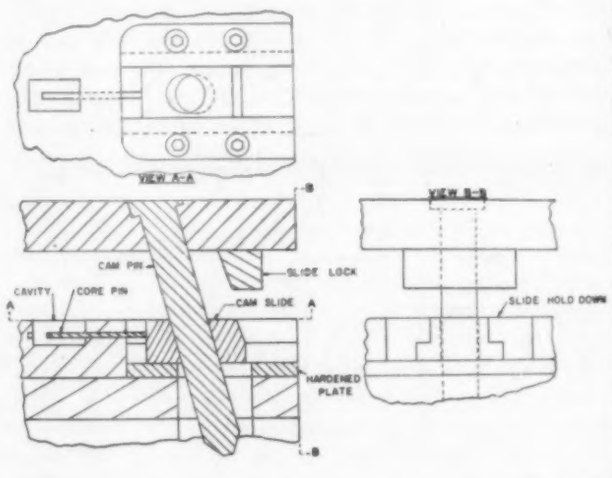

Fig. 1. Round pin type of mechanical cam action. Pin is mounted at an angle to direction of mold movement and engages a cam slide.

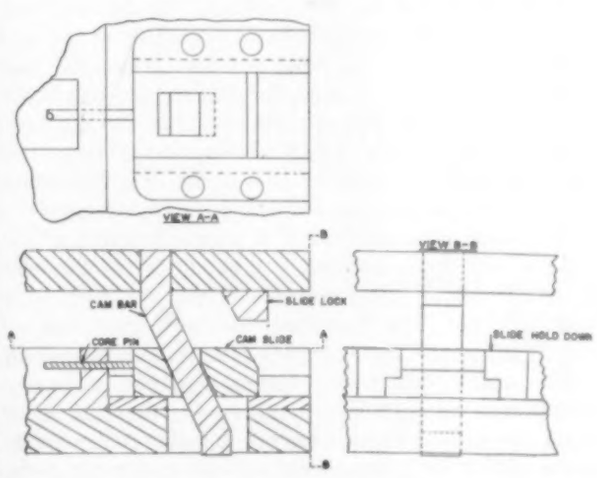

Fig. 2. Square pin cam action has offset bar which permits greater cam force and speeds greater or less than mold movement itself.

William Lewi

lished for all moving parts, and standard cam parts should be used in all molds wherever possible.

We have made it a practice to manufacture all cam action units as completely separate mechanisms, so that all working parts can be tested on the bench before the action is installed in the mold. In addition, we can supply finished units as spares for hazardous or high production cam actions.

All of our cam action components, such as cams, guides, base plates, and locks, are made of tool steel hardened, ground, and lapped to give long, smooth service with minimum lubrication. Excessive lubrication should be avoided because the lubricant can work its way into the cavity and contaminate the molded pieces. Instead of tool steel for the cam pins, we prefer to use a pack-hardening steel with a surface hardness of Rockwell "C" 75-80. Such a pin gives good wear properties and has the added advantage of flexibility. Since the pins are set at an outward angle to the mold, their flexibility will permit them to bend and prevent or minimize damage to the mold in the event of serious trouble.

In most cam action molds, the cam actuating part leaves the cam slide and a locking device should be built into the slide. We employ a simple yet positive lock which consists of a spring mounted steel ball on the cam guide, and a notch cut into the cam. When the cam slides into the open position, the ball engages the notch and locks itself and prevents the cam from moving until the cam actuating mechanism is re-engaged. Unless some type of locking mechanism is used, the cam may move out of its proper position and cause a smashed mold.

Wherever possible, even if it means redesign of the mold or part being molded, you should avoid the condition of having the cam slide across the path of a knock-out pin. This condition has been the cause of ruining many new molds at their first trial, and operating molds whose return mechanisms jammed suddenly. Where it is impossible to avoid having the cam move across the path of a knock-out pin, a spring return mechanism should be incorporated into the knock-out plate. Another safety feature is the use of a micro-switch that will stop the molding machine if the knock-out plate does not complete its return stroke before the cam starts to move.

There are other possible dangers in using cam actions, but they can be prevented or minimized by proper mold design and reasonable care in the building of the mold and its cam action.

TYPES OF CAM ACTIONS

Once it has been decided to use a cam action in a mold, the next question is what type of action should be used or, more specifically, which action will best meet the specific requirements of the job.

There are two basic types of cam actions in use, both of which employ the opening and closing of the mold to actuate the cam. In one method, the cam is moved by mechanical means, while the other method uses the mold movement to actuate an outside power (hydraulic, pneumatic, or electrical) to move the cam. This latter method employs a switch or other tripping mechanism on the mold movement.

All types of cam actions require a locking device to set the cam into its final position, otherwise the molding pressure of the material as it flows around the cam will force the cam out of position.

MECHANICAL CAMS

The mechanical cam consists basically of either a pin or guide mounted to one half of the mold at an outward angle. Moving the other half of the mold pulls the cam slide out of the mold or, as in certain isolated cases, pulls a pin into a core. Where a longer movement is needed, a rack and pinion cam is used instead of the pin or guide.

Round Pin Cams

One of the most commonly used mechanical cam actions employs a round pin mounted at an angle to the direction of mold movement, and engaging in a cam slide (see Figure 1). This type of cam action is simple to manufacture and easy to maintain.

To make such a cam, we begin by calculating the proper angle of mounting, not to exceed 20 degrees at any time, for the amount of movement required. We then figure out the length and diameter of the cam pins. Incidentally, we prefer to use two pins on each cam in order to obtain uniform pulling action. The cam block is made with a hole 0.010-0.020 inch larger than the pin diameter, and a locking angle about 10 degrees greater

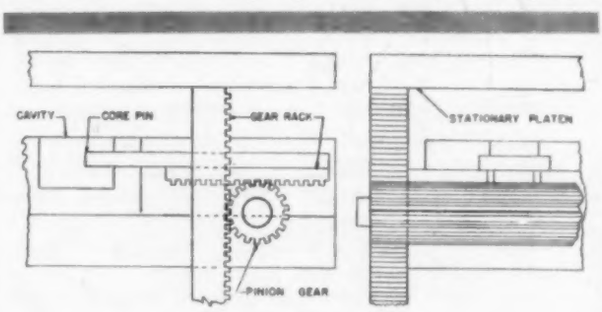

Fig. 3. Side and rear views of rack and pinion cam action. Gear ratio selection provides movement up to triple the mold-opening distance. Cam is suitable for automatic movement of mold parts.

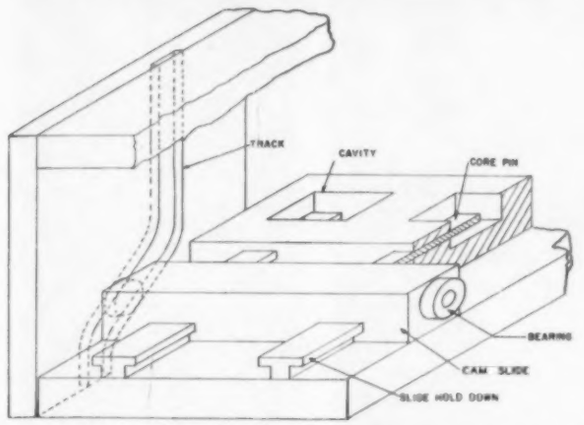

Fig. 4 Sectional view of guided cam action. This method is suitable for moving heavy mold sections or parts requiring continuous support, such as split cavities and large cores.

than the cam pin angle. This assures better locking of the cam and faster breaking of the lock when the mold opens. The extra clearance between the pin and cam slide enables the mold to start opening and relieve the clamping pressure against the side of the cam.

This type of cam is easy to build since the transfer of the cam holes is fairly simple; the tools needed to change or replace parts are found in every maintenance shop; and standard knock-out pins can be used for the cam pins. These factors also add up to lower maintenance costs and easy, quick replacements. A disadvantage is encountered with molds having long strokes in that the pins must be made heavy to prevent bending.

Square Pin Cams

Another popular method is the use of square pin cams (see Figure 2). This type of cam is machined out of solid steel bar stock so that its proper shape must be completely calculated in advance. The hole for the cam must be milled out to the same cross-section as the cam, and this entails a considerable amount of work and fitting.

This type of cam action is used mainly in compression or other molds where a great amount of force is required to pull the cam out of the mold and molded part. The design also permits the cam to be left in the pin at all times, and the cam movement can be slow, fast, or a combination of both to meet specific requirements. This type of movement is not possible with a round pin cam, but the replacement of any broken part requires the services and experience of a good mold shop.

Rack and Pinion Cams

A third method of mechanically moving a cam employs a gear rack mounted to the stationary half of a mold, and a pinion mounted to the movable half (see Figure 3). As the mold opens the gear rack turns the pinion. By proper selection of the gear ratio, it is possible to obtain any amount of movement for the cam slide up to three times the mold-opening distance.

This type of cam action requires much work and great care in building, and much maintenance because of its many moving parts. On the other hand, it provides a high degree of movement and can be used for automatic unscrewing of cores, and for other mold parts that require an automatic movement.

Guided Cams

Another mechanical cam action involves the use of cam guides (see Figure 4). While not in common use, this method is particularly suitable for heavy moving mold sections such as split cavities, big cores, or other parts requiring continuous support.

This type of action consists of a cam slide guided on both sides by plates in which tracks have been milled. Two bearings, one at each end, are fastened to the cam slide, and the bearings move in the milled track. As the mold opens, the cam slide moves down the track and pulls the core pin out of the mold cavity. Closing the mold reverses the travel of the cam slide.

The tracks or cam guides should be made of hardened tool steel, and the bearings should be made of bronze, cast iron, or other material that will wear without damaging the guides or tracks. We prefer roller bearings for this service. Since there is a certain amount of shock and side pressure in the operation of this action on a mold, we have found that the bearing races will crack or flatten unless the track contour is curved instead of angular.

Another advantage of this type of cam action is that, like the square pin cam, the speed of opening or closing of the cam can be controlled and varied. This speed variation is especially important when moving the halves of a split mold.

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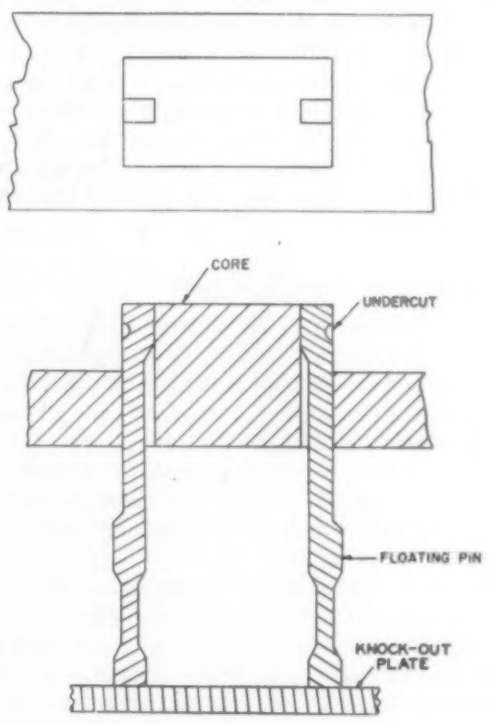


Fig. 5. Floating knock-out pin arrangement for molding undercuts provides simple, dependable operation without complex actuation.

NON-MECHANICAL CAMS

Non-mechanical cams employing hydraulic, pneumatic, or electric mechanisms are used mainly for applications requiring an exceptionally long pull where mechanical cams do not provide enough stroke. The most common method employs an air cylinder to pull the cam out of the cavity. This cylinder is actuated when a switch mounted on the molding machine is tripped by a trigger mounted on the movable half of the mold. This type of trigger action is also used with hydraulic or electric cam mechanisms.

Since the cam action depends on the trigger device and the outside power source (air, oil or water, or electricity), there is great danger of serious damage to the mold if anything should go wrong with either factor. To safeguard against such damage, the design should incorporate a microswitch that is tripped by the cam when it moves into the safe zone, and prevents the mold from striking against the knock-out stop.

Any detailed discussion of non-mechanical cam actions is not feasible in this paper since they are specialized devices engineered to meet the requirements of each specific application.

FLOATING KNOCK-OUT PINS

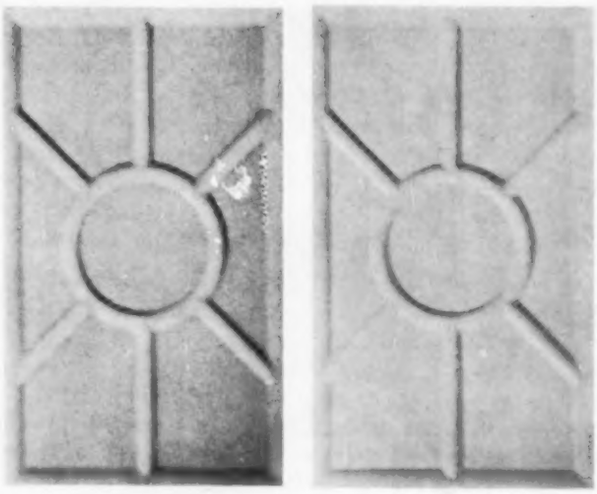
While not strictly a cam action, floating knock-out pins (see Figure 5) can be used to mold undercuts on the force of an injection mold. This system is simple, infallible in operation, and does not require any complicated actuating mechanisms. In essence, the method uses pins that are permanently connected to the knock-out plate and extend to the side of the core. These pins slide or bend sideways when the knock-out plate moves forward.

To build these pins, we grind down the square knock-out pins so that they are actually offset pins. These pins are mounted on the knock-out plate so that the offset section strikes against the underside of the force when the plate moves up. While this action takes place, the angle on the pin rides against the bevel on the force, thereby moving the knock-out in a direction opposite to the undercut.

SUMMARY AND CONCLUSIONS

Brief descriptions have been given of four types of mechanical cam actions, as well as of non-mechanical cam actions and the floating knock-out pin method for obtaining results comparable to those of cam actions. It should be stressed that these descriptions are only outlines since each cam action mold presents specific problems. The mold designer working in conjunction with the molder can decide which cam action and how it will be used for a given mold.

A word of caution is in order here: do not look for a cheap cam action mold because there are none. The original saving in purchase price of a cheap mold will be more than balanced by higher maintenance costs and more frequent breakdowns. The more care that is put into the design and manufacture of a mold, the more good parts it will produce without requiring money for repairs. **The End**



Fiberglass laminate made by conventional methods (left) shows fiber prints and mat bridging on ribs, while part with Lunn Finish No. 107 (right) has a smooth, print-free surface.

New Process Gives Smooth Finish on Glass-Reinforced Plastics

A new process which eliminates tell-tale mat prints from fiberglass-reinforced plastic parts, so that buffing, sanding, and painting are not needed, has been developed by Lunn Industries, Huntington Station, N. Y. The process, called Lunn Finish No. 107, gives a smooth, glossy finish with color pigments spread evenly throughout the surface of the finished part, according to Harry T. Douglas, company vice president.

Research conducted by Lunn on the problem of hiding the glass fiber patterns found the most satisfactory covering material to be a non-woven cotton fabric made by Kendall Mills Co., under the name of Webril R. This fabric is made in various weights and densities, and Grade R-2801 uncalendered was found to give best results.

In production, a part is made in the usual manner with glass fiber and polyester resin, but the Webril R-2801 fabric is placed so that it becomes the working face of the molded part. The fabric is a composition of pure bleached cotton fibers that permits complete resin saturation and provides satisfactory laminating strength. The final finish on the part is then obtained through either matched metal or vacuum bag molding. On deep-drawn matched metal moldings the proper finish is still somewhat difficult to achieve, but this problem is under study and a satisfactory solution is expected in the near future.

Mr. Douglas also disclosed that a fiber-hiding chemically resistant surface has been developed from other non-woven synthetic fiber fabrics. Further details on this development are not available as yet.

Prior to this new process, a part was cured, the flash trimmed and buffed, and the surfaces cleaned thoroughly and painted (usually several coats) to hide the mat prints. The time and labor costs inherent in these operations are now eliminated by Lunn Finish No. 107, opening new fields of application for reinforced plastics.

The Kreidl Process for Better Print Adhesion on Polyethylene

A rapid, continuous process, available in engineered installations, for treating polyethylene to permit use of standard inks and other coatings.

WERNER H. KREIDL, *President, and*
FREDERICK HARTMANN, *General Manager*
The Kreidl Chemico-Physical Co., Columbus, Ohio

The very remarkable chemical inertness of polyethylene is the main reason for its rapid rise in production and consumption. Even the tenfold production increase between 1947 and 1952 and the present output of some 180,000,000 pounds per year seem insignificant when compared with predicted productions of 600,000,000 pounds in 1957 and 1,000,000,000 pounds in 1960, together with a material price drop to 25-30¢ a pound by 1960.

The ever-increasing quantities, however, will not be used in polyethylene's original application field as an insulating material for cables, but will be absorbed largely by the packaging industry to produce film, bottles, and laminates with paper, board, cellophane, and other materials. This development, resulting from such other properties of polyethylene as strength, high flexibility, and low water vapor transmission, is not restricted to the United States, but includes all continents in both respects; the rise in production and the shift in usage.

THE PROBLEM OF PRINTING

This same very remarkable chemical inertness of the plastic was also, until recently, the cause for one of its most serious shortcomings: the difficulty to apply print and adhesives. This is surely a most severe handicap for a material destined primarily for the packaging industry.

In most applications, inks and adhesives are held firmly by absorption to the porous body of the carrier such as newsprint, boxboard, or fabrics made of natural fibers. More difficult to print and glue are what the printing ink manufacturers call "hard surfaces," such as glass, cellophane, etc. With such surfaces, a different type of bond for penetration or adhesion is required.

The bonding forces may consist of secondary valences, as in the case of printing on polar substances like glass and the formaldehyde type resins. For these, inks and glues made of polar resins and oils must be used. Solvents can be used to swell the plastic, thus permitting a surface penetration by chemical means. In many cases of printing or gluing on "hard surfaces," a combination of both methods is used, and special bonding agents, such as petrex acid, are incorporated.

With polyethylene, however, these methods fail if the print or glue is to withstand the wear and tear of commercial use. There are no appropriate solvents for the plastic at suitable temperatures and, since there are no polar forces to speak of in the surface, no secondary valences can be directed towards any of the polar or non-polar constituents of ink or glue.

For a short while there was some interest in printing inks which themselves contained polyethylene, or halogenated or sulfonated polyethylene resins. The idea was to combine ink and surface through their close chemical relationship, but the effect was insufficient. In addition, the inks lacked proper gloss and film strength.

Other endeavors were directed toward printing at elevated temperatures to either fuse the inks or permit solvent action at the high temperatures. Results, again, were disappointing, printing speed was reduced, and safety hazards encumbered the process.

In view of these failures another approach seemed indicated. If no ink would adhere to the surface, clearly, the surface had to be changed. An old and rather crude example existed in the case of celluloid products, where dolls were sand-blasted to get better paint adhesion. With polyethylene the approach, at first, was to oxidize the surface by means of strong chemicals. Chromic acid and other oxidizing solutions of a rather corrosive nature were tried with some appreciable effect. Of these methods, the only one apparently in use today is chlorination in the vapor phase.

In 1948, one of the authors (Kreidl) was the first to utilize physical rather than chemical means to change the polyethylene surface so as to make it receptive to printing inks. At that time the resistance against treatment of polyethylene before printing was still strong, and a fruitless search was in progress for "magic" inks. Today, treated polyethylene is generally accepted for printing.

Today, the Kreidl Process, as it became known, is licensed to the majority of companies producing printable polyethylene. Even if a special ink suitable for "untreated" polyethylene were developed now, the new ink would have only a limited field because of the many

Werner H. Kreidl

special advantages in application offered by treated polyethylene.

THE KREIDL PROCESS

The Kreidl Process (U. S. patent No. 2,632,921, and similar patents in most countries of the world) is characterized by exposure of the surface of the polyethylene article to a high temperature while the bulk of the material is kept at a low temperature. The change occurring in the surface is a gradual one, depending mainly on two variables, time and temperature. Treatment can thus be achieved by either short exposure to high temperatures or longer exposure to moderate temperatures. Hot combustion gases, hot air, exposure to an open flame, or exposure to an electric heating element are some of the means that can be used to achieve the effect.

The treatment is permanent, and the article retains its receptiveness for inks and adhesives. The treated surface is completely unchanged in appearance, and its physical and chemical properties, such as chemical inertness, strength, flexibility, water vapor impermeability, etc., are completely unchanged.

The effect is elusive in that the surface layer affected is so thin that it defies conventional chemical analysis. Infra-red spectra, except for a spurious phenomenon due to interference, at first showed no difference between treated and untreated surfaces. It was only after the technique had been refined considerably that genuine, reproducible changes were observed.[1]

Figure 1 shows a comparison of the infra-red spectra of treated and untreated film. The untreated material was used as a standard; i.e., the spectrograph was set to give 100% transmission on this material at all wave lengths. The plastic was then exposed to flame treatment and its absorption redetermined. A total of 20 surfaces of treated film had to be superimposed to give a noticeable effect, and even then the reduction in transparency amounted to only 2% in the region near six microns.

It is known that the C=O ketone or carbonyl group has an absorption band at 5.85 microns, and that the C=C double-bond carbon group has a band at 6.10 microns. If both groups are present, the bands will often overlap. The minute increase in absorption for the C=C and C=O groups in the treated polyethylene means that the effect of treatment is restricted to a very thin layer, less than 1/100,000-inch.

In addition to these chemical changes there are alterations in the molecular structure of the surface which do not appear in the infra-red spectrum, but are strongly suggested by other experimental evidence. One change is a decrease in the surface orientation of the treated film. The alignment of polyethylene molecules brought about in the extrusion and subsequent streching operation will be broken up by the heat treatment, at least in the top molecular layers. In these layers the crystalline structure will be changed also, in distribution at least, if not in total percentage.

The quenching effect of the treatment brings new bonds to the plastic surface which, particularly in their oxidized form, permit other (mostly polar) substances to unite with them. In simplified language, it could be said that some hooks which were covered are brought out into the open and shaped properly (by oxidation) so that ink particles can attach themselves to the plastic.

How much each of these three factors (oxidation, change in orientation, and change in crystallinity) contributes to the total effect of the flame treatment is the subject of a current investigation.

THE PROCESS IN OPERATION

Any method which permits subjecting the surface of the plastic to a sufficient degree of heat, without distorting the bulk of the material, produces the desired effect. Under plant conditions there are a number of limiting factors which necessitate certain controls and which, from a practical standpoint, characterize the Kreidl Process.

Although the temperature of the main body has to be kept below the distortion point, that of the surface has to be very high to achieve rapid treatment. The source of heat must be very uniform and easily controllable; the heat transfer fast and only superficial; and the

Frederick Hartmann

[1] Unpublished work in cooperation with Kurt Rossman, Ohio State University.

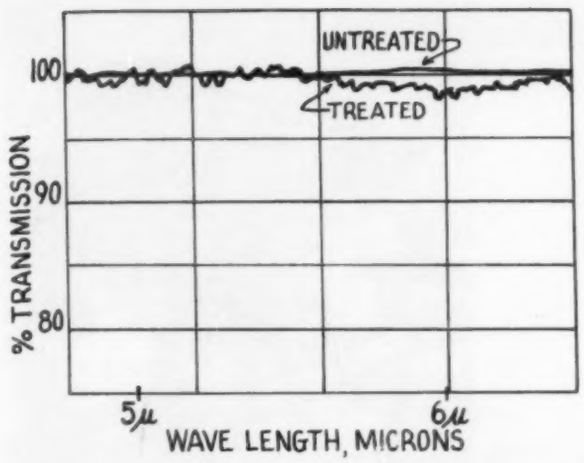


Fig. 1. Comparison of infrared spectra of treated and untreated polyethylene. Results on treated material were obtained by superimposing 10 layers each 0.004-inch thick and flame treated.

equipment simple, compact, and inexpensive. Furthermore, the process must be adapted to fit the particular geometric requirements of the article to be treated.

In all instances the Kreidl Process, as currently performed, consists of treating the polyethylene surface with a stream of very hot, slightly oxidizing gases which move against and along the surface. The article, in turn, is moved through the gas stream by suitable means and at a speed necessary for the effect. Quick cooling will either take place by itself or can be provided.

A typical installation for the treatment of film and lay-flat tubing is shown in Figs. 2 and 3. The film is drawn at constant speed from an unwind or take-off roll over a cooling drum, and onto a wind-up roll. Idlers provide sufficient wrap-around of the film on the drum. Heating, represented by a flame in Figure 2, is directed against the front side of the film while the reverse side is being cooled. Details of the construction will depend on a number of factors, such as the type and speed of the film or tubing, and other data specific for the installation in question.

At first, the treatment was carried out right behind the extruder, and was performed at the speed of extrusion (usually less than 60 feet per minute). Later, however, it was found more practical to run one treating unit for a number of extruders, and treating machines capable of speeds of several hundred feet per minute were developed.

The type of heater and the construction of cooling rolls, drives, couplings, and special equipment to assure good contact between film and cooling device and eliminate air pockets will be different for various requirements.

At first, each installation meant a special engineering job. Later, with engineering help extended by Fred Meyer of Vahlsing, Inc., standardization was carried out so that, at the present time, licensees under the Kreidl Process can be supplied with standard equipment flexible enough to suit specific types of operations.

Treatment of polyethylene coated board and paper can be performed with a machine similar to that used for unsupported film. Although the plastic coating, as such, is often substantially thinner, the treatment requires less control because of the mechanical support provided by the base material. Heat transfer problems are simpler than for unsupported film but, because of the much greater treating speeds, mechanical difficulties must be overcome.

Polyethylene bottles are usually treated at the speed with which they are produced. Equipment is practically standardized along two principal designs; one involving a straight conveyor belt, and the other a turn-table. In most cases these two set-ups are sufficient for handling bottles of all sizes. Thick-walled pipes, used as water conduits or for similar purposes, can be treated easily immediately after extrusion. Heating takes place either all around the circumference of the pipe (if full treatment is desired) or along only part of it (if strip treatment is sufficient). Individual engineering and special treating methods are still required for the treatment of other types of extruded or molded articles.

COST FACTORS

Whether the production of flat film or lay-flat tubing, or a combination of both, will give the most suitable economic results for a specific application should be decided on the basis of type of production, available capital, and nature of the market. Advantages of lay-flat tubing are various sizes (widths) can be obtained with the blowing-up operation, giving good market flexibility; and machines are relatively inexpensive and simple to put in operation. Disadvantages include high labor

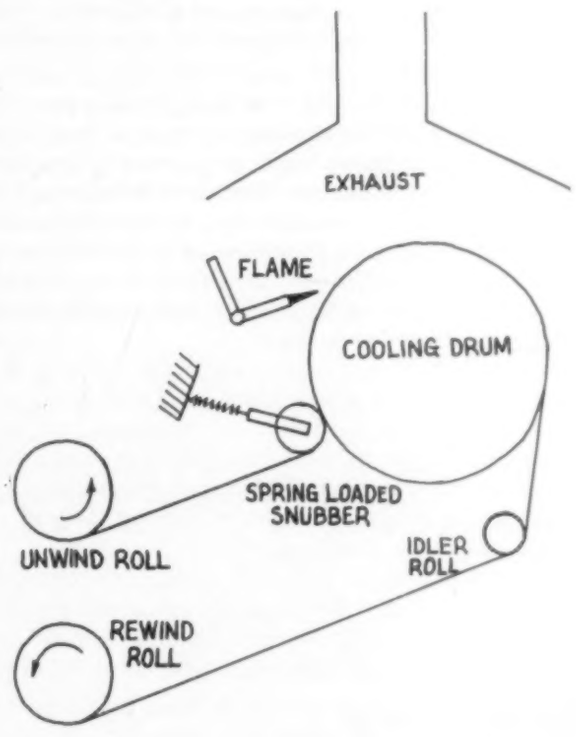


Fig. 2. Schematic drawing of typical installation for treating film and lay-flat tubing by the Kreidl Process.

cost because of the slow extrusion speed; and difficulty in gage control, particularly with small machines.

Flat film, on the other hand, is extruded at several times the speed of the tubing, because of water cooling, and provides reduced labor cost, more uniform gage control, and higher initial cost of machinery. One can over-simplify the situation by stating that lay-flat tubing is usually produced in small or medium sized operations, while flat film is made in large scale production.

The Kreidl Process has followed this diversification, and treating machinery is operated generally at slow speeds for tubing and at high speeds for flat film. The latter type of equipment, however, can be converted readily to slow speed operation for treatment of lay-flat. Rough estimates of equipment and unit costs and other data are given in Tables 1 and 2 for the two main types of operating speeds, each in three web widths. Equipment costs have been divided into two groups, since many companies possess winding equipment which can also be used in the Kreidl Process.

The following simplifying assumptions have been made in obtaining the cost figures given in the tables:

(1) Film thickness is 1.5 mils.
(2) Machinery is in use for 4,500 hours per year (about one-half of total time).
(3) Equipment is amortized in five years.
(4) High speed operation occurs at 360 feet per minute, and low speed at 60 feet per minute.
(5) No winding equipment exists; if it does, costs are lowered.
(6) Polyethylene film price is 66¢ per pound.
(7) Labor costs result mainly from the need for exchanging rolls, while supervision is only of minor importance. Under no circumstances should it be necessary to have a special operator for the process. For the slow speed, narrow width operation less than ¼ the time of one operator is needed; for high speed, wide width operation, 1/3 to 2/3 of his time.

Summarizing the tables, total costs are quite small in relation to the importance of obtaining treated printable film; treatment costs per pound of film go down with increased web width; and costs are lowered by changing from slow to fast treatment. Because of the low ratio of cost to turnover, the process is well suited to the small-scale operator who, by diversification of product or by combination with other operations (such as bag making and printing), can satisfy special demands for which special prices have to be paid.

The process is even more suitable for the large extruder because of the very low overall cost factor per pound of film, and the low initial investment. It was because of this general usefulness that a demand arose for integrated treating units incorporating unwinding, rewinding, heating, and cooling equipment, as well as all controls, in a compact assembly.

Treatment of bottles is quite inexpensive since cost of machinery is low, and there is hardly any labor involved. The picture is similar for pipe treatment, while for laminates the cost situation approaches that for film.

EVALUATION TESTS

Several tests are usually carried out to evalutate the effects of treatment on the adhesion of inks to a polyethylene surface. In all cases one or several types of printing ink are spread on the surface to be tested in a layer of standard thickness by means of a special applicator. The inks are then dried at a given temperature for a specified time before testing is begun. Since some inks have shown a different behavior with the lapse of time, tests are often repeated after intervals of one, 5, 20, and 60 days.

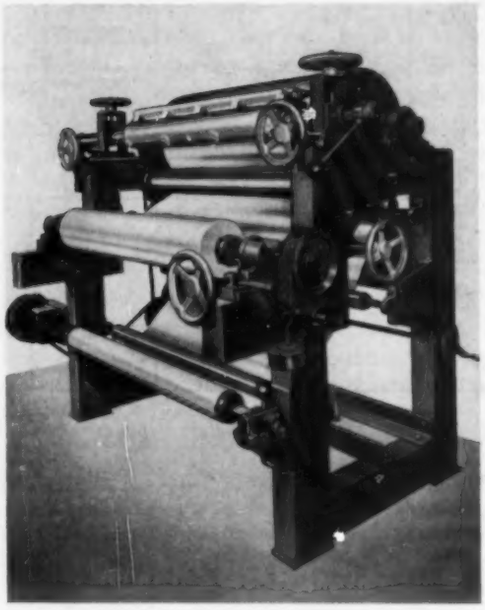


Fig. 3. Machine for treating film by the Kreidl Process, built by Frank W. Egan & Co.

One test consists of crinkling the printed plastic film for a specified number of times in a standard manner, and observing if such treatment removes some of the print. The most widely used test consists of pressing a piece of pressure-sensitive adhesive tape to the printed surface, removing the tape with a strong pull, and seeing if some of the print has been transferred to the tape. This test determines whether the print adheres more strongly to the tape than to the polyethylene.

For film used in packaging vegetables, etc., additional "tape" and "crinkle" tests are sometimes carried out after the material has been immersed in a mixture of ice and water for 24 hours (to simulate shipping conditions where vegetable bags are covered with crushed ice). Any material treated properly by the Kreidl Process will show excellent "crinkle" and "tape" test results, provided that a suitable ink has been used.

In view of the time-consuming and only qualitative nature of these tests, a quick quantitative evaluation technique was highly desirable. One of the authors (Hartmann)[2] developed a rapid, non-destructive, quantitative test for the "degree" of treatment, which characterizes it by a D-number. The test is independent of the type of ink used, and is based on the behavior of polar liquids. It enables users of the Kreidl Process to ascertain quickly whether their treatment of polyethylene surfaces has been satisfactory.

[2] Unpublished work.

Table 1. CALCULATED TREATMENT COSTS FOR LOW SPEED OPERATION

Width, inches	20	40	60
Yearly volume treated, lbs.	200,000	400,000	600,000
Cost of winding equipment	$ 2,000	$ 3,000	$ 4,000
Cost of actual Kreidl Process equipment	1,000	1,500	2,000
TOTAL COST OF EQUIPMENT	$ 3,000	$ 4,500	$ 6,000
Amortization of equipment per year	$ 600	$ 900	$ 1,200
Cost of gas per year	25	50	75
Cost of labor per year	1,000	1,500	2,000
TOTAL COST PER YEAR	$ 1,625	$ 2,450	$ 3,275
Turnover per year	$130,000	$260,000	$390,000
Total cost, as percentage of turnover	1.25	0.94	0.84
Treatment cost per pound of film (exclusive of royalties)	0.81¢	0.61¢	0.54¢

Table 2. CALCULATED TREATMENT COSTS FOR HIGH SPEED OPERATION

Width, inches	20	40	60
Yearly volume treated, lbs.	1,200,000	2,400,000	3,600,000
Cost of winding equipment	$ 3,000	$ 4,500	$ 6,000
Cost of actual Kreidl Process equipment	2,000	3,000	4,000
TOTAL COST OF EQUIPMENT	$ 5,000	$ 7,500	$10,000
Amortization of equipment per year	$ 1,000	$ 1,500	$ 2,000
Cost of gas per year	150	300	450
Cost of labor per year	2,000	2,700	3,500
TOTAL COST PER YEAR	$ 3,150	$ 4,500	$ 5,950
Turnover per year	$800,000	$1,600,000	$2,400,000
Total cost, as percentage of turnover	0.40	0.258	0.25
Treatment cost per pound of film (exclusive of royalties)	0.26¢	0.19¢	0.17¢

This quantitative evaluation of the degree of treatment is important because overtreatment will impair sealability of the plastic. This is of particular importance in bag making where, in the case of flat film, heat sealed center seams are produced. When the film is folded for sealing, an untreated surface may be joined to a treated one, and difficulties may arise regardless of the method of treatment.

With the Kreidl Process it is possible to achieve a degree of treatment, characterized by a specific D-number, which will give excellent ink performance and yet not impair heat sealability. However, control equipment has to be more accurate to keep the treatment within the desired range. If heat sealability is of no consequence, the process is simpler because overtreatment is not critical. To avoid the sealability problem in bag making, film may be "spot treated"; i.e., only strips of a certain width are treated while adjoining strips of equal width are left untreated. This method can be easily applied in the Kreidl Process and, after slitting, will give two untreated surfaces for the formation of the seam.

It has been found that the degree of treatment, apart from time and temperature, depends also on the type of raw material of which the film is composed. Although current manufacturers in this country and abroad usually produce only a few types of polyethylene, announcements of a much larger number have already been made by future manufacturers. The types may differ in molecular weight average, molecular weight distribution, amount of unsaturation, degree of branching, degree of cross-linkage, and other characteristics. Small amounts of other substances may also be added to impart special properties. In view of the great importance of treated polyethylene, it is not improbable that one of these polyethylenes will be custom tailored to meet the special requirements of the treatment process.

ADVANTAGES OF THE PROCESS

What are the advantages conferred by the application of the Kreidl Process to polyethylene products?

Film can be printed by any of the usual methods; rotogravure, flexographic (or aniline), letter press, and offset. Inexpensive and commercially available types of inks, some of which are of proven value in the printing of other plastics, can be used. The print will withstand the wear and tear of a consumer item such as a table cloth or a summer drape, or the rubbing and flexing to which a packaging material is exposed.

That inexpensive "regular" inks can be used is a matter of great economic importance. Ink costs for an average print, covering about one-third to one-half of a surface, are still many times the total cost of the Kreidl treatment of the whole surface. Any special ink developed to adhere to untreated material, therefore,

would be uneconomical if its price were only about 15% above that of regular ink, even in the improbable case that it adhered as well to untreated surfaces as regular inks do to treated ones.

It is also evident that the treated surface will take all sorts of lacquers and coatings very well. A wide choice of overprint varnishes, such as for gloss or for fat resistance, simplifies the achievement of special decorative and functional effects.

Furthermore, it is a particular advantage that treated and printed bags and packages can be marked or imprinted by the packer with conventional marking equipment (rubber stamps, etc.), and again by the retailer to designate prices, rebates, sizes, etc. No such marking of any degree of permanence is possible on untreated bags. Regular paper labels can be affixed and will stick to treated polyethylene, while on untreated material they will pop off after drying.

APPLICATIONS

Bottles and other containers can be silk screened or offset printed. They can be decorated with decals, or unpretentious paper labels can be attached. The latter is important because of the partial replacement of glass bottles in chemical and other laboratories by unbreakable polyethylene bottles. Burets, pipets, ampoules, and vials can be provided with calibration marks, opening new uses to the chemist.

Dolls, playthings, and utensils can be decorated by brushing, spraying, silkscreening, or other process. A similar treatment can be extended to fashion items, such as ladies' belts. Cables and coated wires, the original end-products of the polyethylene industry, can be striped, marked or imprinted. Pipes for water conduits, ect., could show length designations and the producer's name. The rough handling to which such pipes are frequently exposed has persuaded many producers to use hot stamping, with the disadvantage that wall thickness was reduced together with the working pressure to which the pipes could be subjected.

Finally, new applications have recently been opened by the Kreidl Process in the field of polyethylene coatings and laminations. This group includes paper, board, and fabrics coated with polyethylene, as well as laminations with cellophane, foil and other substances. Here, the improvements in receptivity to print and to adhesives offer equally interesting new uses.

While it is true that in most coated paper or board applications the plastic coating is on the inside and the outer paper or board is printed, this arrangement often creates serious gumming difficulties. In the making of boxes, for example, there occurs in the closing operation an overlapping of polyethylene (in the closing flap) and board (in the outer surface) which, because of the inertness of the polyethylene necessitates the use of expensive adhesives with sometimes uncertain results. If the polyethylene is treated, and this can be done by the Kreidl Process right on the laminating machine, inexpensive water-base glues will effect a firm closure of the two materials.

Printing the polyethylene side of such boxes gives beautiful and special effects owing to the gloss and smoothness of the plastic cases. In cases where the polyethylene is intended to act more as a water barrier than to protect the contents against the board material, it would be advantageous to put the polyethylene on the outside of the box and print on it.

This field is still in a very active development stage and, in many cases, the best use to which the treatment can be put has not yet been discovered. A number of manufacturers here and in other countries, convinced of the permament advantages of "treated" polyethylene, are carrying out intensive investigations to find new applications for the treated plastic.

SUMMARY AND CONCLUSIONS

The continued expansion of polyethylene applications has been handicapped by the chemical inertness of the material which presents serious problems in obtaining proper adhesion of printing and glues to the surface of the plastic. The Kreidl Process, characterized by exposing the surface of the polyethylene product to a high temperature while the bulk of the material is kept at a low temperature, provides a permanent treated surface that is highly receptive to inks and glues.

The Process is continuous and rapid, and is available in complete installations engineered to handle film, layflat tubing, squeeze bottles, coated board, and other products. Evaluation tests can be performed to check treated polyethylene and prevent overtreatment which can impair sealability of the plastic.

The Process permits the use of standard inks and other protective coatings on polyethylene parts which may then be further marked and stamped with shipping and other symbols. The treatment has opened new fields of application for the plastic which are now under extensive development.

Monsanto Chemical Co.'s Texas City, Texas, plant and the Montreal plant of Monsanto Canada, Ltd., were declared the 1954 winners of the president's trophies for the best plant safety records. Monsanto's overall accident frequency rate was 1.14 major injuries per million man-hours, as compared with the latest National Safety Council figures showing a 4.53 average rate for the chemical industry, and 7.44 for industry as a whole.

The Texas City plant, winner among the large plant group, currently has operated 505 days for a total of 3,400,745 man-hours without a major injury. Montreal's top safety record among the small plants showed 424 days and 267,675 man-hours without a major injury.

Introducing Our

Editorial Advisory Board

As indicated on the contents page of this issue, a 12-man Editorial Advisory Board has been set up to assist the editors of PLASTICS TECHNOLOGY by providing expert opinions on the accuracy and value of technical articles submitted for publication. In addition to reviewing articles, the board members also provide advice on occasional problems or questions, and on new developments worthy of treatment as technical articles.

Each of the board members is a recognized authority on one or more phases of the plastics industry, and has a responsible position in the industry. Organization of the board and selection of its members was done in such a manneer as to provide the broadest possible coverage of the different branches of the industry.

Thus, for plastics materials and questions relating thereto, we have three advisors: C. Howard Adams, Gordon B. Thayer, and D. Lorin Schoene. The field of machinery and equipment is represented by three men: Hans E. Buecken, Norman J. Elder, and Adolphe J. De Matteo. Ernest J. Csaszar is the advisor on tools and moldmaking.

The field of plastics processing and fabricating is represented by the following five men: Saul Blitz (injection molding and vacuum forming); John Bolten, Jr. (film and sheeting); Harry T. Douglas (reinforced plastics); Albert A. Kaufman (extrusion); and John H. Woodruff (thermoset molding).

Brief biographies of the board members are given here in alphabetical order:

C. HOWARD ADAMS

Mr. Adams is a group leader and technical service supervisor in the research department, plastics division, Monsanto Chemical Co., Springfield, Mass. Born in Bergen, N. Y., he received his bachelor's degree in chemical engineering from the University of Illinois in 1939, and a master's degree in mechanics from the same university in 1945. He was employed as a chemical engineer by Jos. E. Seagram & Sons during 1939-1940, and in 1940-1941 was assistant chief chemist for American Plastics Corp. He joined Monsanto in 1945, after serving as group leader for an Office of Scientific Research & Development chemical engineering project at the University of Illinois during 1941-1945. A member of Tau Kappa Epsilon, Mr. Adams is also active in the Society for Testing Materials, American Institute of Chemical Engineers, and the American Society of Mechanical Engineers.

SAUL BLITZ

Mr. Blitz is president of Tico Plastics, Inc., New York, N. Y., an affiliate of Noma Electric Corp. A native New Yorker,

he attended the College of the City of New York, Pratt Institute (Brooklyn), and Boroughs Polytechnic (London, England). He joined Noma in 1947 after having been associated with Plastic-Ware, Inc., from 1937-1939; Caldwell Products, Inc., 1939-1941; Ideal Plastics Corp., 1941-1943; and Leaf Plastics, Inc., 1946-1947. A past president of the New York Section of the Society of Plastics Engineers, Mr. Blitz is also a member of the Plastics Molders Guild, and the Plastics Education Commission of the New York City Board of Education.

JOHN BOLTEN, JR.

Currently general production manager of Bolta Products Division, General Tire & Rubber Co., Lawrence, Mass., Mr. Bolten is also president of Bolta-Carpart, Inc., and a director of Bolta-Argentina, Bolta Plastics Ltd. (Canada), and Bolta-Werk (Germany). A native of Germany, he received his bachelor's degree from Dart-

mouth College in 1941 and joined The Bolta Co. in 1941. He was vice president of Bolta from 1946-1954; president of Bolta Products, Inc., from 1947-1954; and became president of Bolta-Carpart in 1952. Mr. Bolten assumed his present duties in April 1954 following the merger of Bolta Co. and several of its subsidiaries with General Tire. He is a member of the Society of Plastics Engineers and the Society of the Plastics Industry, and is active in civic and religious affairs in his community.

Charles Mayer Studios

HANS E. BUECKEN

Mr. Buecken is manager of the plastics machinery division of National Rubber Machinery Co., Akron, O. Educated in mechanical and aeronautical engineering at the University of Aachen in his native Germany, Mr. Buecken came to the United

States in 1930 on a scholarship to the Daniel Guggenheim School of Aeronautics of the California Institute of Technology. The following year he was appointed chief engineer of the Daniel Guggenheim Airship Institute. In 1935, he became a special engineer on the Department of Agriculture's Soil-Wind Erosion Project at CIT. After two years of experience with resistance welding machinery, he joined NRM in 1939 as an engineer, in which capacity he designed and developed the company's line of plastics extrusion equipment. Mr. Bueckeen was apointed to his present position in 1946 when the plastics machinery division was established, and has been with NRM ever since, except during the period from September 1952 to April 1954 when he was plant manager for Extruders, Inc. He is active in SPE and SPI.

Lorstan Studios

ERNEST J. CSASZAR

Mr. Csaszar is presently chief engineer of Eagle Tool & Machine Co., Hillside, N. J., and a consulting engineer for Research Molding Corp., also of Hillside. Born in New Jersey, Mr. Csaszar received a bachelor's degree in mechanical engineering from the Newark College of Engineering in 1940. He was chief engineer for Universal Plastics Corp. in 1940-1944; did research on plastics applications at the Naval Ordnance Laboratory from 1944-1946; and joined Eagle Tool in 1946. In his present position, he is in charge of mold design and construction for Eagle Tool. Mr. Csaszar is an active member of SPE and SPI.

ADOLPHE J. DE MATTEO

Mr. De Matteo is chief engineer for Watson-Stillman Co., Roselle, N. J., manufacturers of molding presses and hydraulic equipment. Born in Plainfield, N. J., he received his education at New York University with a degree in mechanical engineering in 1945. After being associated with Thomas & Betts Co. from 1935-1940, and Mack Mfg. Co. from 1940-1944, he joined Watson-Stillman in 1944, becoming assistant chief engineer in 1949 and chief engineer in 1951. Mr. De Matteo's activities include memberships in SPE, ASME, and the Society of Automotive Engineers.

Fabian Bachrach

HARRY T. DOUGLAS

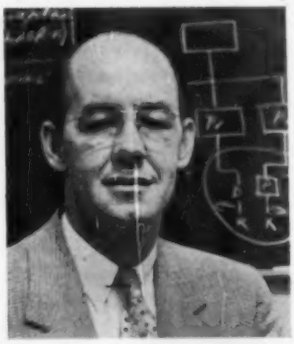
Mr. Douglas is vice president of Lunn Industries, Huntington Station, N. Y., and Ashtabula, O. Born in New York City, Mr. Douglas graduated from Mineola High School in 1936. From 1936-1940, he was export manager for Wilson & Co. After serving as a major in the Army from 1940-1946, he was traffic manager for Rogers International Corp. in 1946-1947, and joined Lunn in 1947. He is a member of SPE, SPI and the Reserve Officers Association.

NORMAN J. ELDER

Mr. Elder is vice president and manager, calender division, Adamson United Co., Akron, O. A native of Pennsylvania, he received a bachelor's degree in mechanical engineering from the University of Akron in 1941. He joined Adamson in 1946 after serving as assistant chief draftsman for Morse Instrument Co. from 1942-1944, and as a naval engineering officer from 1944-1946. He is a member of ASME, the University Club of Akron, and the Ohio Society of Professional Engineers.

ALBERT A. KAUFMAN

Mr. Kaufman is president of Industrial Synthetics Corp., and its division, Supplex Corp., both in Garwood, N. J. A native of Czechoslovakia, Mr. Kaufman studied electrical engineering at the Swiss Federal Institute of Technology, Zurich, and the Technical University of Charlottenburg, Germany, and chemistry at the University of Paris. He was employed by various Dutch and German firms, and finally became president of Ferrolyte Corp., Paris. From 1939-1940 he served as a captain in the Free-Czechoslovak Air Force, and then became manager of development and production for the Fibron Division, Irvington Varnish & Insulator Co. He joined Industrial Synthetics in 1942 as general manager, becoming president in 1946. Mr. Kaufman's experience in plastics molding, extrusion and extruder design dates back to 1930, and he is very active in ASTM, SPE, and SPI.



D. LORIN SCHOENE

Dr. Schoene is assistant director of research and development for Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. A native of Missouri, he was educated at Central College and Iowa State College, receiving his bachelor's and doctorate degrees in chemistry in 1935 and 1939, respectively. He joined U. S. Rubber in 1939 in their general laboratories, then worked for the company's plantation division in Indonesia from 1939-1942. He has been with Naugatuck since 1942, where he has also held the position of manager of organic research and manager of plastics development. He is a member of Sigma Xi, the American Chemical Society and its Rubber Division, and the Connecticut Rubber Group, and is active in SPI and the plastics committees of the Manufacturing Chemists' Association.

GORDON B. THAYER

Mr. Thayer is head of the molding section, plastics technical services, Dow Chemical Co., Midland, Mich. Born in Jackson, Mich., he received his bachelor's degree in mechanical engineering in 1934 from the University of Michigan. He was with General Industries Co. as a tool and design engineer from 1939-1941. He joined

Pincombe Studio

Dow in 1941 as a group leader in the saran development laboratory, and was appointed to his present position in 1947. Mr. Thayer is currently the chairman of the ASME Rubber & Plastics Division, and is also active in SPE and SPI.

JOHN H. WOODRUFF

Mr. Woodruff is thermosetting division manager, vice president and a director of Auburn Button Works, Inc., Auburn, N. Y. A native of Auburn, he attended Phillip Exeter Academy and received a bachelor's degree in physics from Yale University in 1941. Prior to joining Auburn Button in 1945, he was an engineer for Geotechnical Corp. in 1941-1942, and a research associate at Harvard University from 1942-1945. He is a member of SPE and SPI.

Farrel-Birmingham Reshuffles Own Machine Tool Subsidiary

Consolidated Machine Tool Corp., wholly-owned subsidiary of Farrel-Birmingham Co., Inc., has dissolved as a separate corporation. Its business and production activities will now be conducted as a division of the parent corporation. The new division will be known as Consolidated Machine Tool Co., and will continue its production of machine tools in Rochester, N. Y.

According to Frank Headley, president of Farrel-Birmingham, and Lester D. Chirgwin, president of Consolidated, the move was made for the purpose of simplifying the administration of both organizations, and will entail no physical changes other than minor ones in the accounting and billing departments.

Farrel-Birmingham has plants in Ansonia and Derby, Conn., and in Buffalo, N. Y. The subsidiary was acquired in 1951 by the purchase of its common stock from its owner, the former Arthur H. Ingle.

News of the Societies

New SPE National Officers Elected at Annual Conference

The election of new national officers and a new record registration of approximately 1,700 persons featured the 11th annual National Technical Conference of the Society of Plastics Engineers, Inc., held at the Haddon Hall Hotel, Atlantic City, N. J., on January 19-21.

The new officers for 1955, elected by the Society's national directors, are as follows: president, Frank W. Reinhart, chief of organic plastics section, National Bureau of Standards, Washington, D. C.; vice president, Ernest P. Moslo, president of Moslo Machinery Co., Cleveland, O.; secretary, Jules W. Lindau, III, Southern Plastics, Inc.; and treasurer, Haiman S. Nathan, Atlas Plastics, Inc. In addition to these officers, the Society's executive committee also includes J. T. Bent, Eastman Chemical Products, Inc.; J. W. La Belle, Foster Grant Co. and past national president; and P. W. Simmons, Dow Chemical Co.

The three-day conference saw the presentation of some 68 technical papers and panel discussions at the morning and afternoon sessions. Other highlights included the annual banquet on January 20, at which the chief address was given by Brigadier General C. J. Bondley, Jr., Strategic Air Command, U.S.A.F.; the annual business luncheon on January 20; a formal luncheon and talk by John La Cerda, Poor Richard Club, on January 21; and a full program of activities for the ladies.

At the banquet, retiring national president John W. La Belle was presented with a gavel in token of the Society's appreciation for his efforts during the past year. Incoming president Frank W. Reinhart, in a brief talk, predicted continuing growth for the Society during 1955, and called for the cooperation of all the members to assure this growth.

At the business luncheon, national membership chairman J. P. Healey, Manco Products Co., announced that 961 new members were added during the past year, making a membership total of approximately 3,500. In addition, three new SPE local sections have been granted charters: Central Indiana Section; Kansas City Section; and Pacific Northwest Section.

Also at the business luncheon, D. F. Hoffman, Evans-Winter-Hebb, Inc., and administrator of the SPE program on professional activities, announced plans for the Society to publish a series of engineering manuals, beginning with revisions of the books on "Injection Molding of Plastics," by Islyn Thomas, and "Plastics Mold Engineering," by W. I. Pribble. Rights to these books have been signed over to the SPE by the authors.

SPE national officers for 1955: (l. to r.) secretary, Jules W. Lindau, III, Southern Plastics, Inc.; vice president, Ernest P. Moslo, Moslo Machinery Co.; president, Frank W. Reinhart, National Bureau of Standards; and treasurer, Haiman S. Nathan, Atlas Plastics, Inc.

ACS Appoints NBS Committee

A committee has been appointed by the American Chemical Society to render advisory services in connection with the National Bureau of Standards' programs in chemistry. The chief concern of this committee will involve work with two NBS divisions: Chemistry, and Organic and Fibrous Materials.

The latter division investigates plastics, rubber, textiles, leather, and papers—polymeric materials which are characterized by long chain-like molecular structures. Fundamental properties of natural and synthetic high polymers are studied to develop better methods and equipment for the evaluation and production of commercial products.

Norum Addresses Buffalo Section

Robert Norum, surface coating division, Bakelite Co., described the production and applications of plastisols and organosols in a talk before the Buffalo Section, SPE, at the Park Lane on December 10. He stated that plastisols are dispersions of finely ground vinyls in a plasticizer that is not a solvent at room temperature, and that organosols are basically plastisols to which a volatile thinner has been added to lower the viscosity.

Plastisols can be foamed, and also can be used to make molds in less than half the time required to produce other types of plastic molds. Other applications include slush moldings, potting compounds, fillers for electrical cables, sprays, dips, and coatings. Organosols are usually used as fine spray coatings to protect metal surfaces from abrasion, oil, and grease.

New directors and officers of the Section for the coming year were announced. New board members are: R. A. Baumgartner and R. W. Miller, Carborundum Co.; H. J. Deney, Pierce & Stevens, Inc.; K. L. Ditzel, Lucidol division; and R. D. Thilk, Vorac Co. The new officers are: president, Paul H. Bronnenkant, Sterling Molders; vice president, Eugene C. Roeck, Durez Plastics & Chemicals, Inc.; secretary, Robert W. Miller, Carborundum Co.; and treasurer, Edmond A. Leone, Curbell, Inc.

Western New England Section Features Cost Estimating

The regular dinner meeting of the Western New England Section, SPE, took place on January 5 at Bradley Field, Windsor Locks, Conn. Approximately 80 members and guests attended the meeting, which featured talks on "Cost Estimating in the Tool Shop," by Alvino Aliberti, A. & M. Tool & Die Co., and "Estimating Costs of Molded Parts," by George W. Martin, Nome-Lites, Inc.

An additional feature was the showing of a 12-minute movie on the subject of "Production Plating of Tin Strip Stock," presented by Arthur W. Logozzo, Nutmeg Chrome Corp.

Mr. Aliberti used a sample cost estimate sheet to outline his discussion of mold cost problems from the estimator's point of view, evaluating the cost of a job in terms of labor and material requirements. Mr. Martin defined production cost estimating and traced the steps involved in arriving at the estimated price of the finished piece.

ASTE to Meet in Los Angeles

The 23rd annual meeting of the American Society of Tool Engineers will be held in conjunction with the first ASTE Western Industrial Exposition in Los Angeles, Calif., March 14-18.

The technical sessions will be co-sponsored by the Southern California Section, SPE, and the Los Angeles chapter of the American Society for Quality Control. Of particular interest should be the topic of the March 15 morning session, "Plastic Tooling for Production," under the chairmanship of Walter H. Kadlec, president of the Southern California Section.

Scheduled addresses and speakers at this session are as follows: "Improved Designs for Plastic Tooling," John Delmonte, Furane Plastics, Inc.; "Cast Plastic Tooling As Used in Aircraft," Louis E. Frost, North American Aviation, Inc.; "Reinforced Laminates in Aircraft Tooling," Richard Morozowicz, Douglas Aircraft Co.; and "Are Plastic Tool Standards Needed?" George C. Adams, Rezolin, Inc. The session moderator will be G. J. Walkey, Lockheed Aircraft Corp.

Expanded Plastics Panel at N. Y.

The January 5th meeting of the New York Section, SPE, was held jointly with its Reinforced Plastics Group at the Gotham Hotel. Following dinner, announcements were made of tentative programs for the year and the appointment of the following committee chairmen: membership, A. S. Jacobs, Augusta Plastics, Inc.; employment, A. L. GeWertz, manufacturers representative; education, H. J. Weber, Rotuba Extruders, Waljohn Plastics, Inc.; and publicity, A. M. Merrill, PLASTICS TECHNOLOGY.

The topic for the evening was expanded plastics and a panel of experts with John Alfers, Bureau of Ships, Navy Dept., as moderator, spoke on six types of resin foams and showed samples of the latest developments in that field.

Don Weyer, Dow Corning Corp., discussed "New Developments in Expanded Silicone Resins," including a process for foaming them in place. New "ready mix" powders obviate the need for hand blending, and require only heat to melt, foam, and cure. Before the final cure, sections can be cut from the foam and reheated to make formed insulation around air-ducts and pipes where foaming in place is not feasible. Physical and electrical properties of the resin permit its use in thermal insulation, radome structures, and electronic applications.

"Expanded Phenolics, New Developments in an Old Reaction" was the subject presented by R. P. Courtney, Bakelite Co., who noted that the foams were considered originally as undesirable end-products of the phenol-formaldehyde reaction. In a properly controlled reaction, inexpensive foams are produced which can be machined and used for insulation or packing. Being thermosetting, foaming in place is not possible. Recently developed "syntactic" foams offer light weight with strength and form retention.

Isocyanate foams, as outlined by Mark Stringfellow, Nopco Chemical Co., in his talk on "Expanded Isocyanate Plastics," are a recent German import. A combination of alkyd resin and diisocyanate they offer temperature stability, moisture resistance, tear strength, good adhesion when foamed in place, and excellent electrical properties. Flexible and rigid foams are both available. The process is relatively simple; diisocyanate is stirred into viscous alkyd resin and copolymerization occurs. The mixture can be poured directly into a cavity and foamed in place.

An expandable vinyl plastic which can be foamed in place at atmospheric pressure was described by Gabriel Goldstein, Interchemical Corp. Called Vynafoam, it can be forced into gasketing channels by a high-pressure pump attached to a spray gun, eliminating the need for pre-cutting and installation of gaskets. Expansion is accomplished by heating the vinyl plastisol with a blowing agent to a temperature of 250-400° F., depending on the formulation.

A continuous extrusion process wherein cellulose acetate is converted to unicellular foam by the flash vaporization of a superheated volatile solvent, was presented by John Valentine, Strux Corp., in speaking on "Cellular Cellulose Acetate." CCA offers temperature stability, buoyancy, machineability, and ease of bonding. The material must be fabricated to shape; it cannot be foamed in place.

Polystyrene foams offer high impact strength, according to E. A. Edberg, Koppers Co. Shipped in beads, they can be foamed either by the direct introduction of steam into a mold or by the steam-probe method, with an expansion cycle of 20 seconds to one minute. Expanded polystyrene can be foamed in place, reinforced with chopped glass, glued, and laminated.

Following the talks, the speakers were available for questions from the audience of more than 150 members and guests. The meeting closed with the distribution of door prizes donated by Bassons Industries Corp.

Wilkinson Discusses Polyethylene

The January 11 meeting of the Milwaukee Section, SPE, held at the John Ernst Cafe, was addressed by James R. Wilkinson, Bakelite Co., New York, N. Y., whose topic was "Polyethylene, Molding Characteristics and Recent Developments." Fifty members and guests were in attendance.

According to Mr. Wilkinson, polyethylene mold shrinkage is least at high pressure and low temperature, contrary to most other plastics. Since this shrinkage is variable, the use of experimental molds is strongly recommended. Extremely small gates (0.008-0.040 inch) are required for injection molding to obtain the least shrinkage and the best possible surface finish.

Officers of the Section for the coming year are as follows: president, John A. Verburg, Continental Can Co.; vice president, Jack K. Godfrey, Sunlite Plastics, Inc.; treasurer, George A. Stein, A. O. Smith Corp.; national director, Eugene Slingluff, Sunlite Plastics, Inc.; and secretary, Walter F. Just, Jr., B. J. Plastics.

Ontario Section Debates Ethics

The Ontario Section, SPE, held a panel discussion on "Business Ethics in the Plastics Industry" at the St. Regis Hotel, Toronto, on January 11. Approximately 65 members attended the meeting, over which Barnett Danson presided as moderator.

J. H. Wallace, Dulev Plastics, Ltd., spoke on mold design, amortization, and the cooperative use of mold dies. Engineering aspects were presented by R. Harrison, Consolidated General Electric Co., Ltd. He felt that machinery equipment suppliers invite captive molding by

supplying misleading information on costs, and thought that the industry should provide technical information to customers.

J. Fuller, Rainbow Plastics, said that molders should be better informed on cost data, since varying quotations left poor customer impressions. He also stated that there should be an extra tax on imported moldings to compensate for mold cost.

Gordon Beatty, Micro Plastics, Ltd., was critical of raw material suppliers competing with their customers, and passing on information about a processor's activities to his competitor.

Panel on Tooling For Plastics

Approximately 200 members and guests of the SPE New York and Newark Sections attended a panel discussion on "Tooling For Plastics" at a joint dinner meeting at the Military Park Hotel, Newark, N. J., on January 12. E. B. Soules, Detroit Mold Engineering Co., acted as moderator of the open forum which followed the presentations by the panel members.

Ernest Csaszar, Eagle Tool & Machinery Co., spoke on "Advantages and Limitations of Making Plastic Mold Components by the Process of Machining." He pointed out that many factors enter into the selection of the method to be used in making mold components, such as the type molding to be done, anticipated production, cost, and shape of the part. Advantages of machined molds were said to include almost limitless selection of materials to be used, multiple cavities possible in a given space, and wide range of mold sizes.

"Hydraulic Hobbing in Steel" was discussed by Edmund Spitzig, Newark Die Co. In mold die hobbing, a hardened, polished steel master is sunk into a relatively soft metal under heavy hydraulic pressure, and the cavity produced is then highly polished. Hobbing is done where sections are not readily machined, and where bosses, shoulders, thin sections, and undercuts are not required. Mr. Spitzig listed three steels as suitable for hobbing, and stated that hobbed cavities are not always limited to carburized steel; water and oil hardening tool steels being used in some instances. Bullet, ball, and cone shapes can be sunk to considerable depths in these steels. Shallow flats, such as wall tile, have also been hobbed.

Joseph P. Healey, Manco Products, Inc., discussed "Pressure Casting of Beryllium Copper." Savings could be instituted not by using this material as a cheaper substitute for steel, but in the shorter work time required in applications for which beryllium copper is suitable. Typical situations suggesting its use would be high hob mortality rate, prohibitively expensive hobbing, and jobs requiring thin projections, engraving, fluting, serrations, or complicated parting lines. The alloy's thermal conductivity adapts it to the high heat involved in processing nylon gears and industrial parts, and its mold release factor finds application in polyethylene molding.

"Electroformed Cavities" were explained by W. J. B. Stokes, Stokes-Trenton, Inc., as a new method of making molds by plating a part to the desired metal thickness. A $\frac{5}{32}$-inch nickel-cobalt layer is plated with crystalline copper to produce a non-corrosive mold which does not require protection in storage, as does steel. "Master" models of plated brass or plastic are prepared for the electroforming bath by coating with conductive silver and attaching the electrical connections. Nickel plating requires about 12 days, and copper is deposited at the rate of $\frac{1}{32}$-inch per day.

Richard Savage, Marco Products department, Celanese Corp. of America, concluded the discussion with a talk on "Molds for Low Pressure Molding of Reinforced Plastics." Tooling for low pressure molding is governed by the same factors governing injection molding tooling; namely, economics, molding method, size of part, and number of units to be produced.

Wire and Cable Symposium

The Wire Communication Branch of the Coles Signal Laboratory, Signal Corps Engineering Laboratories, Fort Monmouth, N. J., held its third annual symposium on technical progress in communication wires and cables at the Berkeley-Carteret Hotel, Asbury Park, N. J., December 7-9. Twenty-four papers by industrial, governmental, and military specialists were presented to the 562 representatives of commercial and governmental organizations in attendance.

A wide range of subjects was covered in the technical addresses, and summaries of those of immediate or long-range interest to the plastic industry follow:

"The Effects of Conductor Temperature on the Quality of Extruded Vinyl Wire Insulation." E. E. Griesser and M. M. Suba, Bakelite Co. The effects of conductor preheating and other variables on the quality of extruded vinyl wire coatings were discussed and their importance emphasized. Heat shock failures were said to be capable of being overcome by extruding the compound at or above optimum temperature.

"The Effects of Soil Microorganisms on the Physical and Electrical Characteristics of Radio Frequency Cables." Alex Rogel, Signal Corps Engineering Laboratories. Fungal degradation of plastic formulations is caused by plasticizer breakdown or actual utilization by the microorganism of the plasticizer in the protective jacket, although not all plasticizers are thus attacked. Mr. Rogel conducted his study with a variety of cable types and such plasticized coverings as chlorinated polyethylene and vinyl resin, as well as jackets of unpigmented, unplasticized nylon and polyethylene. After 30 months of soil exposure, he observed that the least fungus growth, and consequently the least electrical impairment, occurred on the jacketings of pigmented blue Rulan chlorinated polyethylene and on those of the unpigmented nylon. The pigmented black vinyl jacketing showed the most growth. However, Mr. Rogel concluded that a 30-month period is not sufficient to seriously impair any of the materials tested.

"The Natural and Artificial Aging of Wire Jackets." Charles W. Hamilton, Robert I. Leininger, and G. M. L. Sommerman, all of Battelle Memorial Institute. Although the authors were particularly concerned with nylon jackets, GR-S synthetic rubber, Perbunan-vinyl, and low-temperature vinyl materials were also tested. Ultraviolet light and heat were shown to be the principal factors affecting the degradation of nylon, the former causing cleavage of the molecule, the latter resulting in cross-linking with subsequent cleavage. GR-S and vinyl withstood both the natural and artificial aging tests better than nylon, while Perbunan-vinyl failed the mandrel-wrap test after 6-9 months exposure.

"Engineering Polyethylene for Wires and Cables." E. J. Burrough and E. E. Lewis, E. I. du Pont de Nemours & Co., Inc. The chemical structure and preparation of polyethylene were discussed exhaustively by the authors. To achieve greater crystallinity and toughness, short chain branching in the resin molecule was striven for, and the result was the development by Du Pont of Alathons 3 and 5, both of high crystallinity and high molecular weight. Further improvements in this field were said to be forthcoming.

"Irrathene 201 Irradiated Polyethylene—a New Cable Insulation." P. A. Goodwin, General Electric Co. In addition to offering all of the advantages of conventional polyethylene material—low loss characteristics at all frequencies, high dielectric strength, excellent barrier to moisture, chemical inertness, low sepcific gravity, and good mechanical properties—Irrathene 201 can be used at high temperatures and is highly resistant to environmental stress cracking. Furthermore, it offers the possibility of encapsulation of conductors or various electrical devices to provide a homogeneous, water-tight case.

"Quality Control of Vinyl and Polyethylene Electrical Insulating and Jacketing Materials." R. C. Boyd, Bakelite Co. A quality control system consists of routine surveillance of three items: raw materials, process, and finished product. Discussing a vinyl insulating material consisting of vinyl chloride resin, ester plasticizer, calcium carbonate, clay, and lead stabilizer, the author outlined the process by which these raw materials are fabricated into a finished extrusion product, sketched in the properties of the component items and the final substance, and then detailed the system of control necessary to achieve this.

"Kel-F Elastomer—a New Material for the Electrical Industry." M. E. Conroy and L. E. Robb, M. W. Kellogg Co. This paper summarized the compounding and significant properties of this newly-developed material as related to its potential application in the electrical industry.

"An Evaluation of Vinyl Hook-Up Wires," A. H. Lybeck and S. J. Trykowski, William Brand & Co., Inc. This treatise evaluated three polyvinyl chloride insulation test compounds used for hook-up wire to determine their basic electrical, physical, and chemical properties; suitability for throughout a range of operating temperatures; and the effect of high temperatures on electrical and physical characteristics.

NEWS of the INDUSTRY

SPI Reports 1954 Resin Production Below 1953; Gain Predicted for 1955

Benefiting from a definite last-quarter spurt, domestic production of plastic resins and molding materials in 1954 was only about 3% below the record totals of 1953, according to a year-end report from the Society of the Plastics Industry, Inc., New York, N. Y. Production in 1954 is estimated at approximately 2,714,000,000 pounds (1,357,000 tons) of synthetic resins, as compared with 2,776,627,000 pounds (1,388,313 tons) in 1953.

SPI estimates that approximately 2,849,000,000 pounds (1,424,500 tons) of plastics raw materials will be produced in 1955; an increase of about 5% over the 1954 level. The Society further estimates that the value of all finished plastics products will be approximately $1,357,000,000 for 1954, and $1,425,000,000 for 1955.

Synthetic resins production figures, and the SPI estimates for 1954 and 1955, are given in the following tabulation. Statistics for the years 1922-1953 are taken from United States Tariff Commission figures.

Year	Production, Lbs.
1922	5,944,133
1927	13,452,230
1928	20,411,465
1929	33,036,490
1930	30,867,752
1931	34,179,000
1932	29,039,000
1933	45,200,202
1934	56,059,489
1935	95,133,384
1936	132,912,821
1937	163,030,410
1938	130,358,652
1939	213,027,548
1940	276,814,363
1941	428,325,692
1942	426,731,106
1943	653,332,000
1944	784,137,000
1945	818,020,000
1946	994,277,000
1947	1,251,699,000
1948	1,480,876,000
1949	1,491,111,000
1950	2,150,518,000
1951	2,431,408,000
1952	2,333,924,000
1953	2,776,627,000
1954	2,714,000,000
1955	2,849,000,000

The first nine months of 1954 showed a pronounced decline in resin production from the corresponding months of the previous year, but this downward trend was sharply reversed in the last quarter. Since the record totals of 1953 corresponded to an increase of about 20% over 1952, the SPI considers the 1954 over-all decline as a normal adjustment.

SPI sales statistics, covering 136 representative molders, extruders, and moldmakers, reveal that thermoplastic and thermosetting molders had gross sales billings for the first 10 months of 1954 down 4.5% and 17.8%, respectively, from the comparable period of 1953. Sales billings for molds and dies remained approximately the same as for the previous year, while extrusion of thermoplastics showed a slight gain. A comparison of these sales volumes for the first 10 months of 1953 and 1954 is as follows:

	1953	1954
Thermosetting	$ 84,596,653	$ 69,111,598
Thermoplastic	109,428,731	104,962,382
Extrusion	18,450,590	19,675,717
Molds	12,835,785	12,688,600
Totals	$252,311,759	$206,438,297

There is a recovery movement clearly evident in the plastics industry as a whole, SPI says, and this recovery will be extended through the early months of 1955. Good business prospects are particularly indicated for molded expanded polystyrene, housewares, buttons, reinforced plastics, vacuum formed parts, melamine dinnerware, polystyrene wall tile, plastic piping, toys, and film and sheeting.

Fiberglass Panel Sales Rising

Production and sales of translucent fiberglass panels in 1955 should reach 50 million square feet, almost double the industry's output last year, according to John S. Berkson, president of the Alsynite Co. of America, San Diego, Calif., and chairman of the SPI reinforced plastic sheet committee.

Factors contributing to this substantial advance include industrial glazing, new designs possible with fiberglass awnings, and shatterproof shower doors.

Added production facilities should enable Alsynite to increase its operating space to 88,000 square feet, and its sales volume to more than $10 million from the estimated previous high of $6½ million, he further stated.

Plastic Glazing Improves Industrial Lighting

Plant lighting has been improved, maintenance costs cut, and replacement costs eliminated by the use of translucent plastic materials at Fulton Iron Works, St. Louis, Mo. Six sheets of corrugated, glass fiber reinforced polyester laminate, each 12 feet by 26 inches by 1/16 inch were assembled into glazing sections 12 feet square. These were alternated with pressed cellulose panels of the same dimensions, replacing half of the continuous glass pane and sash which was formerly used as a source of natural light.

Interior view of Fulton Iron Works plant, St. Louis, Mo., showing the difference in illumination with plastic glazing *(upper left)* and conventional glass *(upper right)* as seen by lighting on opposing rows of vertical columns and on the areas near the windows.

The laminate, manufactured by Alsynite Co., San Diego, Calif., and based on a Paraplex polyester resin developed by Rohm & Haas Co., Philadelphia, Pa., is tinted light green and said to provide a pleasant, daylight effect. The diffused light furnishes a stronger illumination, free from glare and shadow, than did the clear glass.

Installation was accomplished by removing the sash and welding two 5/16-inch steel studs on 4-inch centers at the top and bottom of the exposed framework. The panels were mounted on the studs with corrugated rubber strips on both sides, and the edges were caulked to make them watertight and vibration-free.

A total of 120 translucent sheets were used to replace the glass and the wood sash along the west side of the building, just half the area formerly provided by the glass. Despite this halving of the light-transmitting area, Fulton reports more effective illumination of the work floor, and plans to install the polyester glazing throughout the entire plant.

Airco Acquires Two Plant Sites

Air Reduction Co., Inc., New York, N. Y., has awarded the contract for construction of its new vinyl acetate monomer plant at Calvert City, Ky., to Lummus Co., New York, N. Y. Scheduled for completion early in 1956, the plant will have a capacity of 30-million pounds per year, and will represent an expenditure of approximately $3,000,000.

The new installation will receive an important raw material, acetylene, by pipeline from the adjacent production unit of Airco's National Carbide division. In turn, the recently acquired nearby Elkton, Md., plant of Colton Chemical Co., another Airco division, will be supplied with vinyl acetate monomer.

The Elkton facility to be placed in operation this year, will produce polyvinyl acetate emulsions and alcohols for use in adhesives, paints, coatings, sizes, and other synthetic resin products.

Trade Names For Foams

New trade names for three foam rubber and plastic products have been announced by The General Tire & Rubber Co., Akron, O. These are "Fashion-Foam" for mattress rubber latex foam; "Fashion-Foam I.S." for isocyanate-base plastic foam for applications in furniture, shoe soles, cushioning, and air filters; and "Fashion-Foam P.V." for a polyvinyl chloride foam used in padding and cushioning.

New Plastics Company Formed

A new corporation, Augusta Plastics, Inc., 3820 Boston Post Rd., New York 69, N. Y., has recently been formed and will specialize in custom injection molding and packaging. The company offers complete service to the trade, including product design and development, mold engineering, finishing, decorating, and assembly of plastics and metals.

The firm's president, Arthur S. Jacobs, formerly headed Renewal Mfg. Co.'s plastics division, and was in charge of the industrial division of Ideal Plastics Corp. Vice president Joseph J. Eder has been in the packaging field for the past 16 years, most recently serving as vice president of Stanley Sapery Co.

All sales for Augusta Plastics will be handled by Stanley Sapery Co., at the same address.

Expects Demand for Chemicals

The chemical industry will have a bright outlook in 1955, according to Herbert W. Mason, Jr., vice president of Reichhold Chemicals, Inc., White Plains, N. Y. Successful transition from a civilian-plus-military market to an entirely civilian economy was not easy, but most chemical producers were able to adjust to the new competitiveness and conditions of supply and demand, he further noted.

To maintain sales volume and compete in a buyer's market, manufacturers were forced to scrutinize production and selling costs. Lower-cost production of chemicals, retrenchment of personnel, and reduction of shipping costs through moving of bulk chemicals by water, were of primary importance, Mr. Mason added, and Reichhold intends to build new chemical plants closer to their markets. Plans are being completed for strategically locating four formaldehyde plants to serve regional customers with fast, low-cost deliveries.

Reichhold hopes to broaden the use of its chemical products through intensified research, particularly in the field of reinforced plastics. The company's Polylite brand of polyester resins finds applications in the manufacture of plastic boat hulls, auto bodies, truck roofs and other parts, corrugated structural sheets, and pipe for conveying corrosive liquids.

Hungerford Buys Walsamer

Hungerford Plastics Corp., Rockaway, N. J., has purchased the equipment, inventory, business, and good will of Walsamer, Inc., Riverdale, N. J., for an undisclosed sum, and has entered into a long-term lease for the Walsamer plant.

Walsamer, Inc., will be operated as the plastisol molding division of Hungerford. The new division will be managed by Wallace Quackenbush, former Walsamer president, and plans have been completed to increase production of vinyl plastisol and rigisol plastic materials.

Lunn Buys Tool and Die Plant

Purchase of Ueber Tool & Manufacturing Co., Detroit, Mich., reportedly makes Lunn Laminates, Inc., Huntington Station, N. Y., reinforced plastics fabricators, the first to offer the auto industry a complete tool and die service employing all forms of dies; steel, plastics, or combination plastics-steel. Ueber's 55,000-square foot plant will operate as a wholly-owned subsidiary under the direction of Kurt Petrasch, general works manager.

Predicts Barrett Expansion

Carleton Ellis, Jr.

An increased consumption of Plaskon plastics and resin products in 1955 is forecast by Carleton Ellis, Jr., director of plastics and resin sales, Barrett Division, Allied Chemical & Dye Corp., New York, N. Y. Anticipated increases in the sales of established materials, such as polyesters, phenolics, ureas, melamines, and alkyds, as well as the introduction of new products should result in company expansion.

One recently introduced item, a polyethylene wax, has already been well received as a mold release agent for phenolics and vinyls. A new nylon molding compound, scheduled for introduction early in the year, and reportedly possessing greater abrasion resistance, impact strength, gloss, and colorability, is expected to augment wire coating resins sales.

Opens Western Division

Angier Products, Inc., Cambridge, Mass., producers of industrial adhesives and cements, have opened their newly-constructed Western division at Huntington, Ind. John Kerr heads the sales office, and Henry Klos is plant superintendent. Angier products have been used in the manufacture of handbags, synthetic suede, raincoats, shoes, automobiles, tabletops, and others.

Oldsmobile's Delta Features Reinforced Plastic Body

The experimental Delta, a four-passenger close coupled coupe manufactured by Oldsmobile Division, General Motors Corp., Lansing, Mich., made its debut to the motoring public in the recent General Motors Motorama at the Waldorf-Astoria Hotel, New York City.

Featuring a fiberglass reinforced plastic body, except for the brushed aluminum roof, and wide-set oval recessed headlight housings, dual fuel tanks, front seats that swivel for easy entry, and cast aluminum wheels, the Delta stands 53 inches high, has a 120-inch wheelbase, and an overall length of 201 inches. A chrome cove on each fender crown hides the hood edge, but the entire hood can be raised to reveal the 250-h.p. "Rocket" engine with 10:1 compression ratio.

Oldsmobile's Experimental Delta with Fiberglass Reinforced Plastic Body

New Fields Open to Vinyls

New developments in the field of plastics rank among the more significant 1954 achievements of the B. F. Goodrich Chemical Co., Cleveland, O., J. R. Hoover, the company's president, disclosed in a year-end statement. He further added that high-impact, rigid Geon vinyl resins can now be stamped out on conventional metal stamping machines, thereby opening the field to metalworking manufacturers and bringing plastics into direct competition with such established materials as wood, steel, glass, aluminum, and copper.

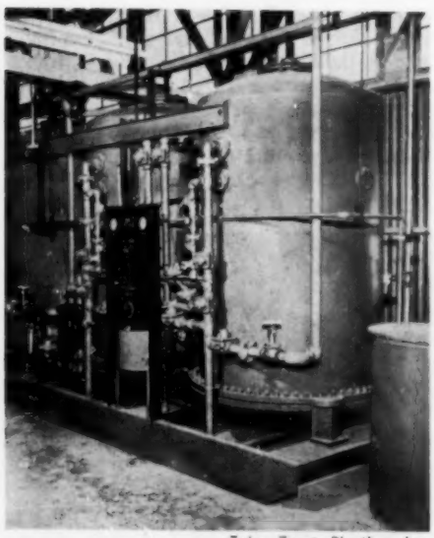
This relatively simple and rapid forming process makes it economically feasible to use rigid vinyl in the building industry for siding, roofing, pipe and tubing, window frames, molding, baseboards, wainscoting, and paneling.

Vinyl foam sponge is expected to be one of the most promising applications of Geon plastisols. Non-flammable, odorless, and unaffected by oxygen, ozone, and most solvents and chemicals, the foam is attaining wide usage in the manufacture of mattresses, pillows, and cushions. Mr. Hoover also pointed out that properties of this type of vinyl can be altered easily to meet the requirements of special jobs.

G-E Saves with PVC Piping

Material costs for a major piping installation at General Electric Company's Appliance Park, Louisville, Ky., are said to have been cut about 50% by the use of unplasticized PVC rather than stainless steel. The corrosion resistant piping carries deionized water for washing GE refrigerators with an alkali-water solution prior to enameling, and in milling frit.

Water is carried through the pipe under 300 psi total head pressure. Main lines are two inches in diameter and laterals are ¾ and 1½ inches. Injection molded fittings and flanges, manufactured exclusively by Tube Turns Plastics, Inc., Louisville, Ky., are employed in making directional changes.



Tube Turns Plastics, Inc.

PVC Piping at G-E Plant

Foster Discusses Chemical Industry Expansion

The chemical industry continued its expansion during 1954, completing over $1 billion worth of privately financed construction projects, according to William C. Foster, president of the Manufacturing Chemists' Association, Inc., in a speech before the Business Forecast Seminar, Chamber of Commerce of the United States, Washington, D. C., on December 16, 1954. Another $1½ billion is under construction or planned for completion within the next three years.

This expansion appears to support the Paley Report prediction that the chemical industry will quadruple its productive capacity by 1975. Future financing should not meet with difficulties, since 1954 sales approximate the record-setting $19.865 billion recorded in 1953. 1953 sales totals to September amounted to $15.185 billion, as compared with $15.222 billion for the same period last year.

The inventory position of the chemical industry is reportedly good; September totals show $1.46 billion, or 13 million less than the previous month. Though $21 million higher than a year ago, this is not considered excessive in the light of today's diversified demands.

It was further stated by Mr. Foster that four major problems challenge the future of the chemical industry and the country; future resources of energy, the effects of new technology and changing economic conditions on human health, technical training of personnel, and advancement of fundamental research.

Chemicals and chemical techniques will have to at least partially replace natural resouces within 50 years if we maintain our living standards at current levels. Toxicological as well as medical and clinical research must be advanced. The number of technical graduates available to industry and research in "pure science" must keep abreast with current expansion; unfortunately just the reverse is true, and we may find ourselves a "have not" nation as far as technical manpower is concerned.

Mr. Foster previously addressed the Drug, Chemical, and Allied Trade Section of the New York Board of Trade on these four problems, November 30, 1954 at the Waldorf Astoria Hotel, New York, N. Y.

Selects Plaskon Alkyd

Glass fiber reinforced Plaskon Alkyd 440-A molding compound has been selected by Hydro Molding Co., Plattsburg, N. Y. for use in the manufacture of six different type coil forms; three are used for aircraft motor applications by Lear, Inc., Grand Rapids, Mich.; two are employed in the high temperature relays of Allied Control Co., Inc., Plantsville, Conn.; and the other goes into a high temperature transformer developed by Freed Transformer Co., Brooklyn, N. Y.

Plaskon Alkyd molding compound was chosen, Hydro declares, because its high heat resistance, strength, dimensional stability, and electrical properties make possible a higher production rate at a lower unit cost.

USI to Market Petrothene

Vincent McCarthy

With the appointment of Vincent McCarthy as sales manager, U. S. Industrial Chemicals Co., division of National Distillers Products Corp., New York, N. Y., has announced its entry into the field of polyethylene resin production. Mr. McCarthy has been engaged in polyethylene sales and production since its inception as a commercial plastic, and is familiar with all phases of thermoplastic raw materials.

U. S. I. will be marketing "Petrothene", which is National Petro-Chemicals Corp.'s brand name for polyethylene resins; the corporation being a joint enterprise of National Distillers and the Panhandle Eastern Pipeline Co. Polyethylene will be produced by a modified I. C. I. process, commencing in April, when the new plant now being built by M. W. Kellogg is completed.

Koppers Schedules Expansion

An amount in excess of $20 million will be spent during 1955 by Koppers Co., Inc., Pittsburgh, Pa., for the construction of new plants, and for the expansion and improvement of present production facilities and equipment, according to W. F. Munnikhuysen, executive vice president.

A considerable portion of this amount will go into the completion of a large polyethylene plant at Port Arthur, Tex., which will be concerned primarily with the manufacture of plastic squeeze-bottles. The plant is expected to start operation around July.

Koppers has established a definite policy of growth in the chemical field, Mr. Munnikhuysen added. Of the firm's six divisions, the chemical division, organized in 1946, now ranks second in sales.

West Coast Plastics Fair

New tools, machinery, and equipment for use in plastics fabrication, as well as entirely new materials and material applications, will be presented at the World Plastics Fair and Trade Exposition to be held in Los Angeles, April 6-10, 1955.

Showings will be highly diversified in content and character, designed to meet the varying needs of processors, laminators, extruders, molders, vacuum formers, and others directly concerned with the plastics field. Additional exhibits will cater to the interests of the plastics-using industries such as aircraft, electronics, petroleum, construction, toys, housewares, hardware, and proprietary marketers.

The exposition is open to engineers, executives, and industrial designers of all interested industries through passes obtainable from exhibitors or the show management. Consumers will be permitted to attend the two closing days and all evening sessions.

Reichhold Expands Offices

The executive offices of Reichhold Chemicals, Inc., White Plains, N. Y., will now occupy the entire 2½-story modern building at 525 N. Broadway. All administrative, sales, foreign, and export departments for the firm's 12 plants in the United States and 30 throughout the world are to be consolidated under one roof. To facilitate plant manager visits, a helicopter shuttle will operate from the two principal New York airports.

The additional space will permit expansion of the sales and research staffs. Plans include an employee cafeteria, a private dining room for special luncheons and dinners, and an enlargement of the chemical reference library.

Plastics Enrollment High

Enrollment in the new series of Plastics Courses offered by Newark College of Engineering, Newark, N. J., has been so great that four additional sections have been added to the two originally scheduled.

The two courses, one on Injection Moldings and the other on Compression Moldings, show a registration of 90 executives and workers in the plastics industry from 29 companies in the northern New Jersey metropolitan area. Plans include expansion to a three-year certificate program beginning in September with the addition of eight more courses, thus offering a complete survey of modern techniques and methods to workers in the industry.

General Tire Purchases Atkin

The General Tire & Rubber Co., Akron, O., has acquired Atkin Mfg. Co., Toledo, O., processors of perforated vinyl, metal, cloth fiber, and fiber-board materials. Jules D. Lippmann, general manager of the Textileather division of General Tire, has been named president of the Atkin company, and it is expected that the new facilities will bring about an expansion of the Textileather operations.

Financial details of the purchase have not been disclosed, but expansion plans include relocation to a larger plant at 1650 Fernwood Ave., in Toledo. In addition to its perforating business, Atkins also holds a license for the manufacture of perforating machinery, for which General Tire anticipates increased production.

Establishes Foreign Division

A new international division of F. J. Stokes Machine Co., Philadelphia, Pa., has been established to administer all of the firm's overseas sales activities. Charles W. Nicholson, formerly export product manager, will direct the operation.

The new division is expected to make the development and testing facilities of the Stokes laboratory and advisory service departments more accessible to the customers of Stokes' local representatives throughout the world, and establish a better system of controls and public relations.

24th National Packaging Exposition Slated for April 18-21

Thirty thousand American and foreign business executives are expected to attend the 24th National Packaging Exposition and concurrent Packaging Conference at the International Amphitheatre, Chicago, Ill., April 18-21, according to the American Management Association, New York, N. Y., sponsors of the event.

With 330 exhibitors already having reserved more floor space than that occupied by last year's record-breaking exposition at Atlantic City, N. J., still more records in attendance, area, and number of exhibitors are expected to be surpassed this year. A total of 375 exhibitors, employing 140,000 square feet of the Amphitheatre's New Exposition Hall and South Hall, is anticipated.

One of the nation's largest annual trade shows, the exposition assembles the latest packaging equipment available for the $10 billion-a-year American packaging industry, as well as displays of materials and services. The entire exposition will be housed on the street-level floor of the Amphitheatre, an ideal situation, AMA says, made possible by the huge size of the structure.

The Packaging Conference, also sponsored by the 20,000-member management educational association, will be held at Chicago's Palmer House during the same period, and is expected to be attended by more than 1,500 packaging executives and technicians. The three-day program will reflect the increasing inter-relationship of packaging and marketing, and the tendency of American business to give packaging staffs representation in the highest council of management, AMA reports.

Industrial packaging and packing will be particularly stressed this year, with emphasis placed on the potential for greater efficiency and cost savings represented by the packaging of both consumer and industrial goods. Standardization, instrumentation, quality control, and the correlation of design in both the product and its package will be explored.

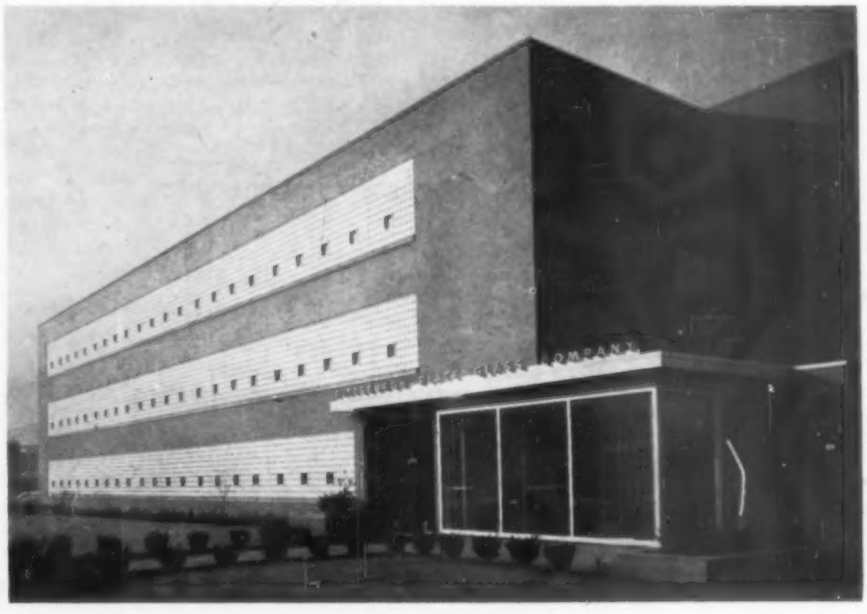
Another facet of the conference will be the delineating of the need for better integration of the packaging and marketing functions and for top-management support of the packaging section. New materials, new packaging procedures, and new sales concepts will be described. Companies to be represented on this program include U. S. Radiator Corp., General Foods Corp., and the Ternstedt, Buick, and A. C. Spark Plug division of General Motors Corp.

Richard Wellbrock, vice president of New Jersey Machine Corp., heads the exhibitors' advisory committee for the event. W. L. Romney, Proctor & Gamble Co., is chairman of the group of 19 executives of AMA member companies which is planning the conference program. AMA staff members assigned to the packaging show include A. K. Thorn and John A. Warren. Admission to both the exposition and conference is free.

New High Polymer Laboratory

The opening of a modern three-story structure to house the basic and applied research laboratories of Pittsburgh Plate Glass Co., Springdale, Pa., was recently announced. Containing approximately 68,000 square feet of floor space and completely air conditioned, the laboratory will be staffed by 85 chemists, engineers, and assistants.

Research in the synthesis of new, high polymer resins for protective coatings and plastics products will occupy a major portion of the plant's facilities. Formulation, application, and evaluation of the new polymers will be conducted in another wing. Space is available for a pilot plant and a materials testing section.



New High Polymer Laboratory at Pittsburgh Plate Glass Co.

The new plastic-bodied UPS delivery truck and one of the early model trucks.

Reinforced Plastic Truck Body Proves a Success in Road Tests

First reports of the eight-week trial period in which truck #47226 of the United Parcel Service delivery fleet underwent vigorous road testing, revealed that the operators who had the opportunity to drive it, uanimously commended its overall performance and appearance. The first delivery truck to have an all-plastics body, #47226 was molded by Lunn Industries, Huntington Station, N. Y., from 19 parts made of fibrous glass mat impregnated with Barrett's Plaskon polyester resins.

Weighing only 650 pounds as opposed to the average 1,700-pound aluminum body, the truck reportedly held the road better than the heavier truck since its light top gives it a lower center of gravity. Absence of joined or metal parts is said to eliminate vibration, and the translucent roof gives the interior more light, making it easier for the driver to read the addresses on packages. Drivers also reported that the splash-free design of the sides and back door prevented water seepage and subsequent damage to parcels.

Results being favorable, UPS has ordered 20 more cabs and truck bodies for further trial. Considerable reduction in maintenance costs in terms of gasoline consumption and tire and battery life have convinced UPS officials of the commercial feasibility of the new trucks. Additional savings in physical upkeep are possible due to the inherent qualities of reinforced plastics; namely, imperviousness to rusting and corrosion, resistance to weathering, and the impossibility of peeling or warping.

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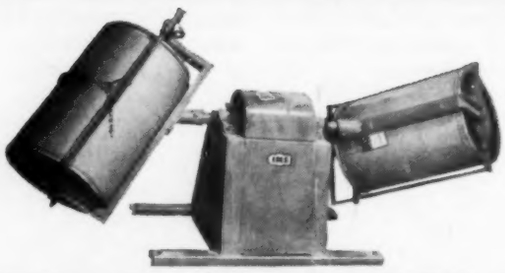

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In Brief . . .

Dow Chemical Co., Midland, Mich., has added a new granulation for dry color blending to their polystyrene line. Designated No. 32, it is slightly larger and more uniform than No. 22 granulation, and is available in Styron formulations 666 and 688, and K27 Crystal.

Flexible Products Co., Marietta, Ga., formulator of vinyl plastisols and organosols, has obtained rotational molding equipment, thus making complete compound evaluation, sample production, and product and mold development available to its customers.

The Transparent Package Co., Chicago, Ill., has announced a change in their corporate name to Tee-Pak, Inc. "Tee-Pak" has been their registered trademark since 1935.

Fellows Gear Shaper Co., Springfield, Vt., makers of gear cutting machinery, has developed a stepped-up installment plan which extends payment terms to 10 years in contrast to the previous three-year plan.

Marblette Corp., Long Island City, N. Y., has named Acorn Adhesives Co., Los Angeles, Calif., and Waldor Enterprises, Montreal, Canada, as sales distributors for their epoxy and phenolic resins. Acorn will cover the western United States, and Waldor will be the exclusive Canadian distributor.

Industrial Research Laboratories, division of Honolulu Oil Corp., San Francisco, Calif., fabricator of Xaloy cylinder liners for manufacturers of plastic and rubber extruder machines, is completing expansion plans in Los Angeles which involve the erection of a new $100,000 plant and the addition of new research and production equipment.

Advance Solvents & Chemical Corp., New York, N. Y., has introduced two grades of silicone catalysts for waterproofing materials, stannous and zinc.

B. F. Goodrich Chemical Co.'s Louisville, Ky., plant has operated for more than two million man-hours without a lost-time accident. Company spokesmen state that contrary to popular belief, the chemical industry ranks among the top nine industries of the country in safety.

News from Abroad

Plastics Expansion in Australia

In Australia, as elsewhere, activity in the plastics industry has expanded considerably since the end of the war. While still largely dependent on imports, the industry is aiming at self-sufficiency, and several factories have been established to produce various plastics. Thus, there are three firms producing phenol formaldehyde; two making urea and melamine formaldehyde; and one, each, for polystyrene, PVC, and cellulose acetate. Phenol formaldehyde is the oldest and quantitatively the most important material made here, and the greater part of Australian needs can be satisfied by local manufacture.

Polystyrene is, at present, the plastic most in demand, but this has not as yet helped local production of the material since converters prefer to buy the cheaper foreign product; so while imports have been mounting, local output has been reduced. Meanwhile, CSR Chemicals, Ltd., early in 1954 began the construction at Rhodes, N.S.W., of a new L.250,000 polystyrene plant. The Distillers Co., Ltd., Edinburgh, Scotland, which holds a 40% share in CSR, will make available some information on plant lay-out and manufacturing processes.

Consumption of PVC is also expanding rapidly; demand being chiefly for use in the manufacture of coated fabrics. This is a war-born industry which received its greatest stimulus after the war. It is estimated that in the period 1948-1953 the output of vinyl-coated fabrics for upholstery, and vinyl sheeting for shower curtains, rain wear, etc., increased by 300%; in 1953 alone, output jumped by another 66%. The product quality is claimed to equal anything brought in.

The only local factory for PVC resins is that of ICIANZ, which at present produces 1,000 tons annually, so that most of the country's needs must be covered by imports, for the most part (90%) from England. The concern is understood to be erecting a new £2,000,000 PVC plant at Botany, Sydney, which is expected to be operating in 1955, and is designed to produce 6,000 tons annually, enough to supply all Australian needs. The firm is also said to be considering the establishment of a polyethylene factory.

Turin Plastics Exhibition

A center of attraction at the Fourth International Exhibition held in Turin, Italy, from September 24 to October 10, 1954, was the plastics section. Here, various Italian, Dutch, and French firms, as well as a sprinkling of firms representing other European companies and a few American companies, displayed an interesting, if not wholly representative range of materials and products.

The joint exhibit arranged by the Netherlands plastics industry was one of the largest, and included glass fiber-polyester resin boats, an injection molded nylon propeller for a motorboat, and a three-piece molded nylon motor housing. Molded colored nylon components were featured by the Rhodiotoce Societa, Italy, which also showed a variety of other molded nylon articles including a complete blood transfusion outfit.

Polyester resins were prominent in the display of the Montecatini firm which showed auto doors and hoods, chairs, and large garbage cans of this material, as well as baby baths of injection molded polyethylene.

Melamine was used to surface wood panels 200 x 100 x 3 millimeters in size, displayed by S.A.X., of Turin. Some of the panels had printed paper or fabric inserts under the transparent melamine tops. Beautifully molded melamine tableware attracted attention at the exhibit of R.I.V. of Turin; this company also showed melamine-surfaced laminated plastic seats for buses and street-cars.

Rigid PVC found application in molded table-tops and vacuum-formed linings for refrigerator doors (shown by Vulcanirga, Milan), and in gutters and leaders (by La Resina). In some Italian cities an increasing number of houses are reportedly being provided with such gutters and leaders, and there is a growing demand for rigid PVC piping for conveying water and methane gas, the latter said to be an important new source of energy in Italy.

One of the most attractive displays was that of Lino Bosco, consisting of very natural-looking flowers, buds, and leaves, all injected molded from tinted polythene. The flowers were even given the fragrance of their real-life models by incorporation, in the molding powders, of appropriate perfumes said to last as long as four months.

Dutch Build HPM Machines

The first injection molding machine produced in the Netherlands under license from the Hydraulic Press Mfg. Co., Mt. Gilead, O., has been completed. The machine, which was built to fill an order for Sweden, is of the HPM 600-H-32 type, with a capacity of 32 ounces. The manufacturer in the Netherlands is the Koninklyke Machinefabriek Gebr. Stork & Co., N.V., of Hengelo, whose active association with the American concern began in 1953.

The Stork company is at present concentrating mainly on HPM No. 600-H-32 and 350 H-16 type machines, but larger machines will be built to special order. At present, the firm is working on another 32-ounce machine, this time for a South American firm. Various orders, among others from Finland, have also been received for the 16-ounce machine.

Incidentally, it can be mentioned that Hydraulic Press Mfg. Co. itself some time ago supplied a French firm with a 200-ounce injection molding machine, said to be the largest in use in Europe.

Spain Regulates PVC Imports

In order to stimulate the Spanish polyvinyl chloride industry, the Minister of Commerce has recently decreed that PVC imports will not be authorized unless importers undertake to buy a quantity of the local product equal to 60% of their foreign purchases. It seems that the Spanish industry is developing very slowly, although the domestic product is said to be competitive with the imported material both as to quality and price.

Airborne Extruder for Pipe

An important new development, which attracted a good deal of attention at the recent annual show of the Society of British Aircraft Contractors, was the "Plastomobile," the Dupont-Windsor Airborne Extruder for plastic pipes. This equipment, developed by Richard E. Du Pont, Du Pont Pipe Co., Jersey, C.I., in conjunction with R. H. Windsor, Ltd., Chessington, Surrey, is designed to permit the extrusion of plastic pipe for conveying oil, water, gas, etc., at the site where it is needed, thus eliminating the delays and heavy costs involved in transporting the usual metal piping, particularly to less accessible areas.

The outfit consists of a suitably modified Windsor R.C. 100 twin-screw extruder in a trailer specially designed to go on a Blackburn Beverly air freighter. The trailer, which is drawn by a 5½ ton towing tractor, is 32 foot long, 9½ foot wide, and 8 foot high, and when fully loaded weighs about 10 tons. It has a rear compartment where the equipment is set up, and a smaller storage compartment in front with space enough to hold about four tons of materials, sufficient for two to three days' production of pipe four inches in diameter and ⅛-inch thick. To insure constant temperature under all climatic conditions, air-conditioning is provided, and the walls and double roof of the trailer are insulated with glass fiber. The rear compartment can be sealed off to keep out dust and dirt, and the extruded pipe is passed out from the take-off gear through a rubber ring in the rear door.

The extruder can produce piping in diameters from ½-6 inches, and has a capacity of 75-100 pounds per hour, depending on the material. It can produce 100-120 feet of four-inch diameter pipe per hour. Pre-drying, pre-heating, and refrigerating units, and a cut-off saw are provided. Power requirement is put at 25 kilowatts, and the 10-hp. motor can be either connected to a power line or driven by a portable generator.

NAMES in the NEWS

William R. Clulo and **Jack C. H. Stearns** have been elected to the board of directors of the Dow export companies, Dow Chemical International, Ltd., Dow Chemical Inter-American, Ltd., and Dow Export Co., bringing the board membership to seven. Both served previously in executive capacities.

James R. Turnbull has been appointed vice president of Monsanto-Kasei Kogyo, K. K., Tokyo, Japan, replacing Albert W. Dunning, who will return to the United States for an assignment with Monsanto's plastics division. Mr. Turnbull, who had been assistant director of marketing for the company's plastics division, will also serve as board member and executive committeeman for the Japanese firm.

Robert H. Krieble has been appointed manager of the chemical development department, chemical and metallurgical division, General Electric Co., Pittsfield, Mass. The department was established to create new chemical businesses for the division's five other departments, and will be an independent operation. Dr. Krieble succeeds Alphonse Pechukas, who has been named consultant-materials and processes, engineering services division.

R. L. Bateman has been appointed director of product development for Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. He will work with **John A. Field,** who was recently named vice president in charge of sales. **W. A. Woodcock** succeeds **Dr. Bateman** as manager of the fine chemicals division and **R. H. Wellman** becomes manager of the agricultural chemicals division.

Robert L. Gibson has been elected vice president of General Electric Co., Pittsfield, Mass. He is general manager of the firm's chemical and metallurgical division. Two other vice presidents named were **Francis K. McCune,** general manager, atomic products division; and **Willard H. Sahloff,** general manager, small appliances division.

Myles J. McGowan has been appointed executive vice president of the Ray-O-Lite Corp. of America, Atlanta, Ga. He has been general manager, and will continue in that capacity in addition to assuming further executive responsibilities.

Atlas Mineral Products Co., Mertztown, Pa., has announced the following in the organization and sales department:

Joseph A. Snook as executive vice president. He formerly served as design engineer, engineering manager, sales manager, and vice president in charge of sales.

Eugene Kirkpatrick as general sales manager. He formerly served as eastern regional sales manager.

George Gabriel as manager of manufacturing. He formerly served as plant engineer and engineering manager.

Gerald F. Gilbert, Jr., as treasurer and purchasing agent. He formerly served as sales coordinator.

George L. Wirtz, Jr., as manager of product planning. He formerly served as purchasing agent.

Kenneth T. Snyder as assistant sales manager. He formerly served as western regional sales manager.

John Swift as pacific coast district manager. He formerly served as Furnane sales engineer.

James Ohman, Robert Spencer, Erik Van Anglen, and **Martin Smith** as sales representatives for the Houston, St. Louis, Philadelphia, and New York districts respectively.

R. J. Werner has been appointed assistant general sales manager in charge of staff sales functions, chemical division, Celanese Corp. of America, New York, N. Y. He formerly served as district sales manager in the Chicago office.

John T. Rucker, Jr., has been appointed administrative assistant to the director of research and development at Hooker Electrochemical Co., Niagara Falls, N. Y. He formerly served as chemical engineer in the research and development department, and was assigned to do research work on Hooker's P-31 Atomic Energy Commission project.

G. Stanley Berge has been appointed marketing manager for the plastics department, General Electric Co., Pittsfield, Mass. He formerly served as manager of the plastics department's custom molding plant at Taunton, Mass. **Arthur T. Bourgault,** previously manager of the alkyd resin products plant in Schenectady, N. Y., succeeds **Mr. Berge. K. O. William Sandberg,** formerly research operations manager in the plastics department, becomes engineering manager.

Edward M. Lemon has been appointed West Coast representative of chemical sales, with headquarters in Los Angeles, for Barrett Division of Allied Chemical & Dye Corp., New York, N. Y., replacing **C. V. Fetty,** who will continue to handle cylinder ammonia sales. **Josef E. Windbiel** will assume **Mr. Lemon's** former responsibilities in the St. Louis territory.

Wallace H. Woodrow has been named a vice president by Hale & Kullgren, Inc., Akron, O. He is in charge of contract engineering work for the company. **Harry E. Tourtilotte,** formerly in charge of plant maintenance and construction for the chemical division of Monsanto Chemical Co., has been appointed a project manager. **Robert L. Guggenheim** has joined Hale & Kullgren and is in charge of machine sales.

R. F. Dettelbach

C. D. Segner

W. E. Manring

B. F. Goodrich Chemical Co., Cleveland, O., has announced the following changes among members of the plastic materials sales department:

R. F. Dettelbach as field sales manager for plastic materials. He had previously served as eastern sales manager.

W. E. Manring as sales development manager. Formerly technical service manager, he will direct market development work for new plastics and applications.

C. D. Segner as plasticizer materials manager. Prior to appointment, he had been a technical staff representative.

Monsanto Chemical Co., Springfield, Mass., has announced the following personnel changes in the plastics division:

Robert J. Schatz

Robert J. Schatz as associate director of research at the Springfield laboratory. He will retain administrative supervision of the division's Seattle and Santa Clara laboratories in addition to his new responsibility.

Francis E. Reese as associate director of engineering. Formerly assistant engineer, he will direct project, design, utility, construction, and development activities for the Springfield section.

Luigi Contini as assistant manager of the market development department. A design engineer, he will be in charge of design research for new and expanded plastics markets.

John C. Garrels, Jr., production manager, has been granted a leave of absence to attend the spring session of the Advanced Management Program at the Harvard University Graduate School of Business Administration.

J. E. Mayl, vice president and general manager of the films, foam, and flooring division of The Goodyear Tire & Rubber Co., Akron, O., has been honored for his completion of 30 years of service with the company.

John McE. Sanderson has retired as assistant to the general manager of the plastics and resins division, after 23 years of service with American Cyanamid Co., New York, N. Y. He intends to remain active in the paint and plastics industries on an independent consulting basis.

W. R. McElroy and **Andrew S. Morecroft** have been appointed group leaders in the research department of Mobay Chemical Co., Anniston, Ala. **Dr. McElroy** will head the process development group investigating processes for products and intermediates and **Mr. Morecroft** will direct the isocyanate foam group concerned with applied research on flexible and rigid foam systems.

Edward F. Swanzey, formerly metropolitan New York sales representative, has been named sales manager of the Chicago district for the chemical division of Celanese Corp. of America, New York, N. Y. He succeeds **R. J. Werner** who assumes new and expanded duties in the New York headquarters. **M. Henry Jamison** has been appointed sales manager of the newly created district sales office in St. Louis, Mo. He formerly served as sales representative for that area.

Harry G. Hoehler has joined the sales staff of Witco Chemical Co., New York, N. Y., and will cover the Philadelphia and Baltimore territories.

Richard B. Tucker has relinguished his position as executive vice president of Pittsburgh Plate Glass Co., Pittsburgh, Pa., and reduced his work schedule to a half-time basis, his former responsibilities being assigned to **David G. Hill,** a vice president of the firm. **Mr. Tucker** will retain his title of vice president, and will continue general supervision of glass research, foreign operations, and the export department.

Charles B. Roen has been named an assistant director of the research and engineering division of Monsanto Chemical Co., Dayton, O. He joined the company in 1946 after having served with Shell Chemical Corp.

H. E. Klein has been named district manager of the Kansas City district of Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp. He has been with the company since 1947.

Frank W. Judson, a 60-year veteran of the sales department of Pittsburgh Plate Glass Co., Pittsburgh, Pa., has retired. In 1935 he was elected a vice president of the firm. He was awarded the honorary title of Ambassador of Friendship at a testimonial dinner given him in 1953 by the glass and steel industries of Pittsburgh and the automotive industry of Detroit.

E. H. Bluman has been elected to the office of vice president of the Harchem Division of Wallace & Tiernan Incorporated, Belleville, N. J. He was formerly executive vice president of W. C. Hardesty Co., Inc., a wholly-owned subsidiary of the firm. Before coming to the United States from his native Germany, **Dr. Bluman** was managing director of Vereinigte Stearinwerke, Hamburg, producers of fatty acids.

Ross R. Fernow and **William M. Artz** have been appointed manager and assistant manager respectively, of glass advertising and promotion for Pittsburgh Plate Glass Co., Pittsburgh, Pa. Mr. Fernow formerly served as editor of "PPG PRODUCTS" and supervised the company's information rack program. Mr. Artz has been associated with the advertising department for several years.

Dwight R. Means, vice president of Columbia-Southern Chemical Corp., Pittsburgh, Pa., will reduce his work schedule to a half-time basis and will serve in various consulting capacities, transferring his relinquished responsibilities to **J. A. Neubauer,** technical director, and **R. L. Hutchinson,** former general superintendent and now assuming the position of general manager of operations. **C. K. Ballard** has been appointed manager of production, and will be succeeded as works manager of the firm's Lake Charles, La., plant by **A. T. Raetzsch,** formerly superintendent of operations there. **N. J. Ehlers** has been named assistant technical director for the company.

William H. Schuette

Max Key

William H. Schuette has been appointed assistant to the general manager of the Midland division, Dow Chemical Co., Midland, Mich. He replaces **F. C. Peterson** who was recently named industrial relations director. **Dr. Schuette** formerly served as plastics production manager.

He is succeeded by **Max Key** who has been assistant production manager in charge of Midland plastics production. In addition to parent company duties, **Mr. Key** is a director and vice president of Asahi-Dow, Ltd., Japan.

James M. Young, III, and **Robert P. Keating** have joined the process study group of Hooker Electrochemical Co., Niagara Falls, N. Y., as chemical engineer and chemist, respectively.

OBITUARY

Louis A. Tomka

Louis A. Tomka, supervisor of technical service, chemical division, Metal & Thermit Corp., Rahway, N. J., died January 4 following cranial surgery.

Born July 25, 1910 in New York City, he was graduated from New York University in 1936 with a degree in chemistry. After having associated with Pantasote Corp., Harte & Co., and Rand Rubber Co., he joined Metal & Thermit's chemical sales department.

A memorial service was held in Gray's Funeral Home, Westfield, N. J., on January 6, followed by interment in Westfield's Fairview Cemetery. Mr. Tomka is survived by a wife and two children.

Meyer Goldman

Meyer Goldman, 41, manager of the quality control department, plastics division, Visking Corp., died January 11, 1955, in his home in Terre Haute, Ind.

A graduate of the University of Chicago, Mr. Goldman joined Visking in June, 1941, as a chemist, later supervising the analytical testing section of the central laboratories.

Mr. Goldman was active in several professional organizations, including the American Chemical Society, Committee D-20 of ASTM, and the Society of the Plastics Industry. He was also a member of the industry advisory committee of the Quartermaster General on plastic film and sheeting.

He is survived by a wife and two daughters.

New Materials

Phthalate Plasticizer—Flexol 426

The availability in tank-car quantities of Flexol 426, a distilled, mixed alcohol phthalate plasticizer for vinyl chloride resins, has been announced by Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y.

The new phthalate reportedly has high solvent power, stability, and compatibility with nitrocellulose, chlorinated rubber, and acrylate polymers. Though more volatile than dioctyl phthalate, it can be used in many products which do not require premium plasticizer performance.

Flexol 426 improves processing characteristics of vinyl compounds such as flooring, profile extrusions, wire insulation, and cable jackets. It can also be used in films, sheeting, and plastisols when low volatility is not a prime prerequisite.

Physical properties of Flexol 426 are listed as follows:

Specific gravity	0.9941
Average weight per gallon, lbs.	8.2
Boiling point at 5 mm. Hg., ° C.	224
Vapor pressure at 200° C., mm.	1.8
Absolute viscosity, cps.:	
At 0° C.	261.5
At 20° C.	60.4
At 40° C.	21.5
Pour point, ° F.	—35
Refractive index	1.4868
Coefficient of expansion at 20° C., in./° C.	0.00076
Surface tension at 20° C., dynes/cm.	30.1
Solubility in water at 20° C.	Insoluble
Solubility of water in Flexol 426 at 20° C., % by weight	0.4
Flash point, ° F.	390

Oil-Resistant Industrial White Ink

A new industrial white ink that can be used on dark, flexible, or highly polished surfaces, and is fast drying, impervious to light, and resistant to flushing oil, grease, and moisture, has been introduced by Time Saving Specialties, Minneapolis, Minn. Called Vaporite Industrial White ink, it may be removed when desired by solvents furnished with each marking set.

The ink is said to be capable of adhering to an almost limitless range of surfaces including plastics, rubber, polished aluminum, glass, rough castings, metal containers, cellophane, wood, photographic film and negatives, varnished or lacquered surfaces, and tile. Designed especially for use with it are the company's Jiffy-Rite felt-nib fountain pen, filled with a squeeze of a bulb, and a base and holder.

Suggested uses for the ink include circling defective holes and rivets, marking parts for production line assembly, code marking, inventory and bin marking, wiring diagrams, marking templates before flushing with cutting oil, marking weights, and production charts.

Pressure-Sensitive Adhesive

A new pressure-sensitive adhesive recommended for application to paper, leather, metal, plastic, and other surfaces, has been introduced by Adhesive Products Corp., New York, N. Y. Labeled Prestix, the new adhesive is a clear, saturated high polymer in a vehicle of aliphatic and aromatic solvents, having a viscosity of 150,000 cps., a solids content of 55%, and a weight of 7.7 pounds per gallon. Reportedly fast drying with a lasting tack, Prestix is suitable for preparing self-sticking pressure-sensitive labels, tapes, and decorative fabrics.

VANDERBILT
MATERIALS
For VINYLS

VANSTAY L

Recommended for Maximum Light Stability and Improved Natural Aging in All Vinyl Resin Compositions.

VANSTAY HT · VANSTAY S

This Combination Provides Excellent Heat Protection for Vinyl Compositions During Processing and in Service.

VANSTAY R

Clear Liquid Heat Stabilizer for Use in Vinyl Compositions.

VANCIDE 89

Non-metallic Fungicide and Bactericide Effective in Vegetable Plasticized Vinyls.

Our Technical Service Representatives Will Gladly Demonstrate the Merits of Our Materials in Your Plant and Assist in Solving Production Problems.

R. T. VANDERBILT CO. INC.
230 Park Avenue, New York 17, N. Y.

Diamond PVC-45 Resin

A polyvinyl chloride resin which can be processed at temperatures of 315-330° F. has been introduced by the plastics division, Diamond Alkali Co., Cleveland, O. The new polymer, Diamond PVC-45, is a fine, white powder said to have good heat stability and electrical properties, and excellent dry blending qualities.

Other specifications include a specific viscosity of about 1.35, a feature which results in lower processing temperatures; bulk density of 33-35 pounds per cubic foot; moisture content of 0.5% maximum; and a screen analysis of 100% through 40 mesh.

Packed in 50-pound bags, the resin can be used in producing vinyl sheeting and film, non-electrical extrusions, and molded products.

Emulsifiable A-C Polyethylene

Three new experimental grades of emulsifiable A-C Polyethylene, Nos. 629, 630, and 631, have been introduced by Semet-Solvay Petrochemical division, Allied Chemical & Dye Corp., New York, N. Y. The outstanding feature of these three materials is reported to be that stable, clear emulsions can be prepared in formulations containing up to 50% solids.

Chemically, these partially oxidized polyethylenes have a molecular weight of about 2000, a low acid number, and only traces of saponifiable material. No heavy metals are present to induce further oxidation, with its associated objectionable odor.

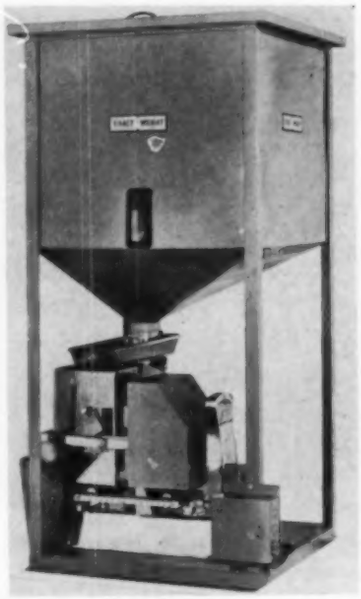
Physically, they are hard, wax-like products which range in color from a translucent off-white to a slight gray-green; their general properties being intermediate between those of a vegetable wax such as carnauba, and the thermoplastics. Important properties are summarized below:

	No. 629	No. 630	No. 631
Melting point, °F.	205-208	205-208	205-208
Penetration, 100 gms., 5 sec., 77° F.	2-4	1.5-2.5	1.5-2.5
Viscosity, Saybolt furol sec., 140° C., 30 cc. efflux	40-50	100-110	80-90
Specific gravity	.93	.93	.93
Acid number	14-17	15-18	16-19
Saponification value	14-17	15-18	16-19

A suggested formula for a water emulsion, as employed by Semet-Solvay, consists of adding eight parts of oleic acid to 40 parts of melted A-C Polyethylene 629, 630, or 631; heating to 120-130° C., and adding eight parts of morpholine. Then, 160 parts of water is heated to 95-98° C. and stirred in slowly. Polyethylene separations can be removed by filtering through cheesecloth.

Other company claims for the new materials include compatibility with waxes; water and chemical resistance at room temperature; high melting point; and low melt viscosity. Applications indicated include coatings, containers, polishes, candles, and electrical insulations.

New Equipment



Exact Weight Weigh-Feeder

Injection Weigh-Feeder

A heavy capacity automatic weigh-feeder for use in plastic injection molding machines which have capacities over 50 ounces has been introduced by Exact Weight Scale Co., Columbus, O. Designated 273-F-O-IM-6, the new weigh-feeder has a 6¾-pound capacity weigh bucket and a 350-pound capacity hopper.

The scale unit is the Exact Weight "Over-and-Under" model 273 precision industrial scale, available with beam and poise in either metric or avoirdupois calibration. Metric provides 100 grams on the beam in two-gram divisions, or 10 grams in ¼-gram divisions. Avoirdupois calibrations have a four-ounce beam with ⅛-ounce divisions, or a 2½-ounce beam with $\frac{1}{100}$-ounce divisions. The scale indicates each charge visibly.

Hopper, feeder pan, weigh bucket, and dump chute are all constructed of stainless steel. Accessories include supply hopper lids and special beams and weights. Automatic compensators are available.

Heli-Coil Screw Inserts

Helically-wound stainless steel and phosphor-bronze wire thread inserts of extra large pitch diameter have been developed by Heli-Coil Corp., Danbury, Conn., to replace solid bushings and provide strong, permanent threads in soft materials such as plastics, aluminum, and wood.

Molding of thread inserts in plastics imposes several limitations on design. Female threads tapped directly into plastics are usually too weak to support practical working loads, and bosses for solid bushings are bulky and subject to local stresses. Heli-Coil Inserts reportedly resist corrosion and, being flexible, adjust to the stress.

The inserts have proved successful with laminated phenolic blocks, fiberglass epoxy laminate, polyethylene, and with acrylic directional control valves and terminal control boards. In the last mentioned application, they provide electrical connections through the panel, and their tangs furnish soldering lugs for connecting wires.

Installation is accomplished by drilling a hole slightly smaller than the outside diameter of the insert, tapping so that the insert can be screwed into the hole, and inserting the wire thread with a standard inserting or prewinder tool. Tangs can be removed manually or by air.

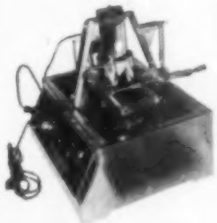
Standard stock inserts run from 4-40 up to 1½-12 in thread sizes. Larger inserts have been formed up to $6\frac{11}{16}$ inches in diameter with 12 threads per inch. Available in N. C., N. F., spark plug, and taper

TESTED IS TRUSTED

Rely on Scott Testers* for evaluation of physical properties of plastics:

TENSILE

Scott Model J, world-standard Tester for tensile and elongation tests.



BRITTLENESS

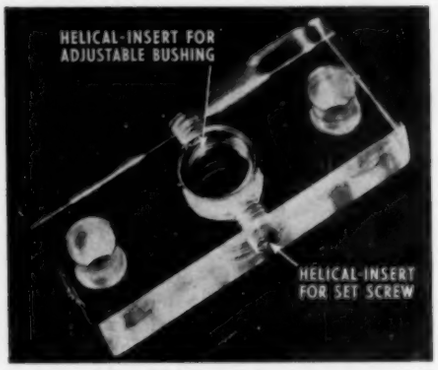
Scott Brittle-Point Tester for ASTM Designation D746-D20 tests plastics at temperatures from —80° to +50°C.

Literature upon request

*Trade Mark

SCOTT TESTERS, INC.

149 Blackstone St., Providence, R.I.



Stainless Steel Heli-Coil Inserts Set In Transparent Acrylic Block

pipe threads, inserts of large pitch diameter can be formed in other thread series, left-hand threads, and double, triple, or quadruple lead threads. Tolerances can be held to 0.0002-inch, and surface finishes from 8-15 mirco-inches can be produced, according to the company. Hardnesses up to Rockwell C50 can be obtained in 18-8 stainless steel. Inserts of Hastelloy "C" and music wire can also be formed.

Thermoplastic Welding Gun

A light, 14-ounce electric welding gun for thermoplastics has been introduced by the industrial plastics division, Seelye Craftsmen, Minneapolis, Minn. Designed and built in Switzerland, the Seelye Plastic Welder operates on 110 volts, with a choice of 180-, 240-, or 320-watt elements.

The welding medium is usually electrically-heated compressed air, although carbon dioxide or nitrogen can be used for special operations. Having a temperature control valve, the gun reportedly joins PVC materials of any size, shape, or thickness up to one inch with 100% material strength. Soft vinyl-sheet material can be heat sealed and acrylics welded.

Rigid PVC and polyethylene pipe can be welded "on the spot" with the use of a welding rod which is listed as additional equipment. The rod is available in diameters up to 5/32-inch.

Laramy Products Co., Cohasset, Mass., is the distributor for Seelye Plastic Welder on the East Coast, and Horace Blackman Co., Culver City, Calif., is the West Coast distributor.

Seelye Welding Gun for Thermoplastics.

H-P-M C-Frame Presses

A new standard line of oil hydraulic C-frame presses, ranging in size from 2-200 tons and said to be particularly timely in an age of increasing automation which has stepped-up the demand for small presses, has been introduced by The Hydraulic Press Mfg. Co., Mount Gilead, O. Sizes include 2-, 5-, 10-, 15-, 25-, 35-, 50-, 75-, 100-, 150-, and 200-ton models. Single or dual safety operating levers, electric pushbutton, foot switch, foot pedal, and other standard types are among the operating controls available.

Incorporated into each model is a high-speed differential circuit and inching control which allows the press operator to "inch" the ram downward or upward while setting dies. The specially-designed open C-gap frame eliminates encumbrances within the tooling area and provide a maximum amount of room for tooling. The 60-second ram stroke adjustment is said to be conveniently located away from the tooling area.

A young product striving to acclaim title to an old reputation.

A product made from expertly selected plastic scrap — processed to specification — compounded, plasticized, stabilized, colored, strained, pelletized, packaged.

- We specialize in VINYL and POLYETHYLENE for molding and extruding purposes
- Polyethylene Color Concentrates
- Laboratory Facilities
- Custom Work
- Scrap Offers Invited

ALPHA

CHEMICAL & PLASTICS CORP.

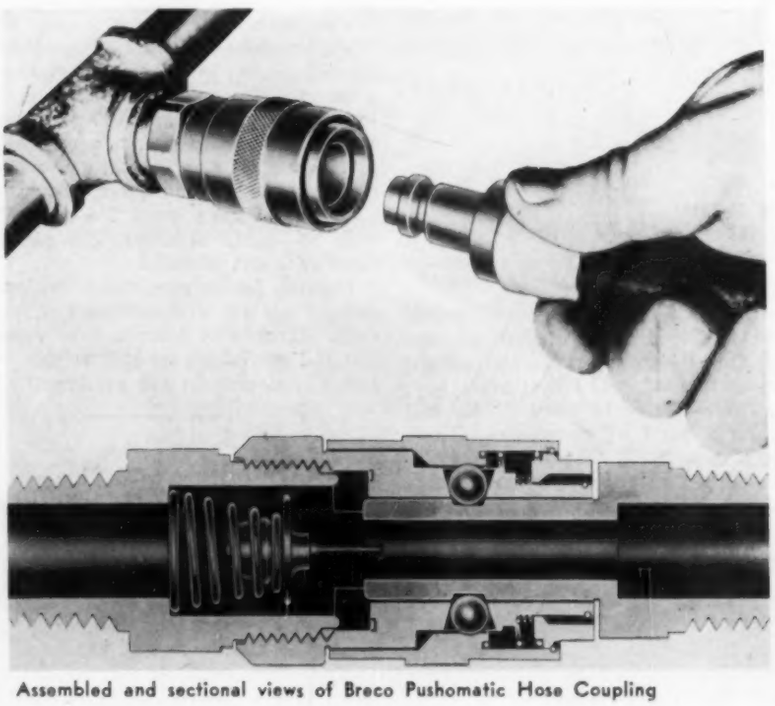
11 Jabez Street, Newark 5, N. J.

MArket 4-4444

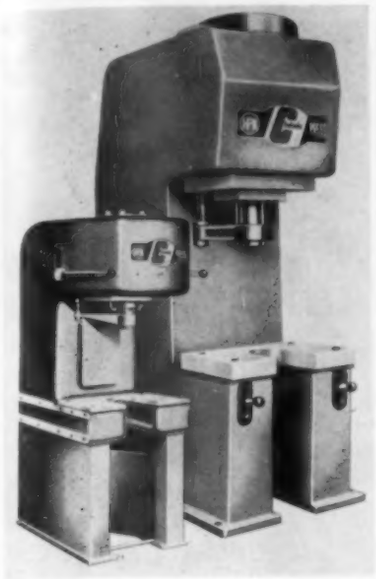
Automatically-Locking Hose Couplings

A complete line of automatically-locking couplings for air, hydraulic, and fluid-handling hose has been introduced by Breco Mfg. Co., Inc., division of Perfecting Service Co., Charlotte, N. C. Called Pushomatic, the line features simple push-in operation for connecting or disconnecting without turning or twisting, and makes high-pressure leak-proof connections easily obtainable.

An integral check valve automatically shuts off the line when the coupling is disconnected, preventing backlashing or whipping. Full 360-degree swivel action, small diameters, and application up to 10,000 psi. are other reported features. Manufactured in a variety of styles and types of couplings and connecting plugs, the Pushomatic line comes in sizes from 1/8- to 3/4-inch.



Assembled and sectional views of Breco Pushomatic Hose Coupling



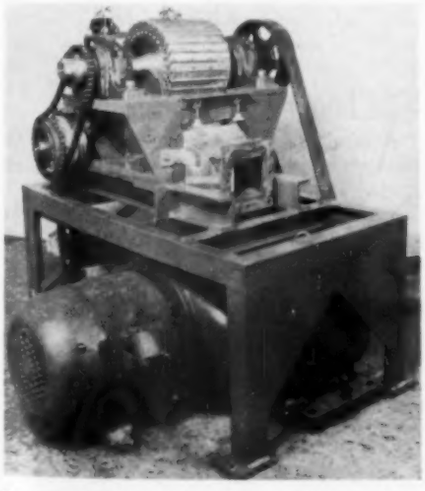
Bench and Floor Models of H-P-M C-Press

Plastic Pelleter

A new series of pelleters has been announced by Taylor, Stiles & Co., Riegelsville, N. J. Named the Taylor-Stiles Pelleter Machine, #700 series, it reportedly produces up to 5,760,000 pellets per minute, operating on wet or dry stock. The pellets are said to be dust-free, and the cuts clean and free from feathers.

Dimensions vary somewhat with the two models; No. 706 has a throat width of 5¾ inches, and No. 710, one of 10 inches which can take 120 rods about 3/64 inches in diameter. Both have fly knives which cut against a stationary bed knife, and are geared for speeds up to 1,600 rpm. The machines are compact and relatively noiseless in operation. Their cutting element, feed rolls, and other parts which contact the product can be stainless steel.

Pulling, stretching, and feed rolls may be designed to suit individual needs. An automatic choke may be placed on the feeds, and safety guards may be almost any desired shape and construction.

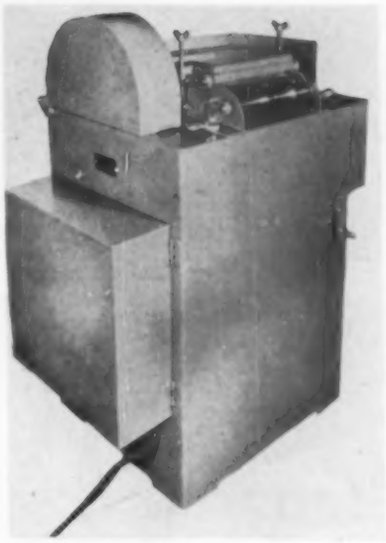


Series 700 Taylor-Stiles Plastic Pelleter

Strand Pelletizer

Production of a new, high capacity pelletizer for extruded thermoplastic strands has been announced by Ball & Jewell, Inc., Brooklyn, N. Y. Driven by a 7½-hp. motor and featuring a Reeves variable-speed drive with a speed range of 33-100 feet per minute, the 1,000-pound machine reportedly can process 800-1,000 pounds of material per hour.

New design features include feed and cutting chambers and pellet discharge chute of stainless steel construction. All parts are exposed and accessible for cleaning. Measuring 12 inches in width, the steel-clad pelletizer normally takes a ⅛-inch strand and discharges a ⅛-inch cubic pellet; however, extruded material up to $\frac{5}{16}$-inch in diameter can be accommodated, and the length of the cut sections can be changed by varying the speed of the machine and the tension of the strand.



Ball & Jewell Hi-Capacity Strand Pelletizer

Redesigned Grinder Hopper

A redesigned hopper with a wider cooling tray has been incorporated into the standard IMS 6½ by 7-inch throat molded part grinder manufactured by Injection Molders Supply Co., Cleveland, O.

The new hopper features an inspection port for determining the fullness of the material catch pan, which has been provided with a lock pin to prevent spilling. The unrestricted throat reportedly has a built-in clearance bar to prevent jamming of large molded parts.

Planer With Carboloy Knife

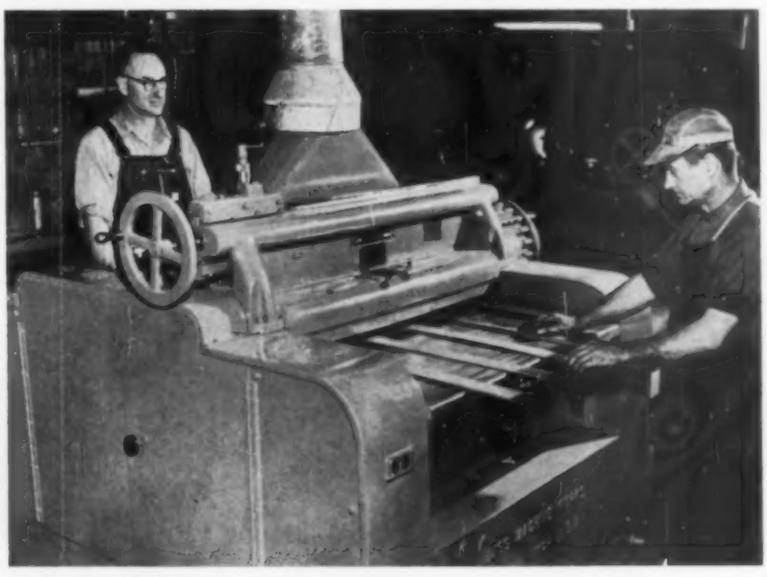
A woodworking-type planer, designed to make use of a 40-inch solid cemented carbide knife, and expected to cut costs for manufacturers of rubber and plastic tile, shoe soles, and brake linings, has been introduced by Buss Machine Works, Holland, Mich. Called the Micro Surfacer, the machine is an adaptation of the firm's single-surface wood planers to the planing of abrasive and flexible materials.

Constructed so that stock-transferring conveyors can be built in, the Micro Surfacer is equipped with safety devices such as shear pin and coupling in the feed drive, micro switches, and electrical equipment such as heaters.

The carbide knife, developed by the Carboloy department of General Electric Co., is said to be much stronger and longer lasting than the steel knives formerly used. Held mechanically in the cutter-head by means of wedges, the Carboloy knife is highly resistant to shock and is capable of close tolerances and clean severing action which result in surfaces free from dust and grit, according to Buss.

This accuracy, the company adds, saves the manufacturer thousands of dollars in reclaimed material by doing away with his shipping of over-sized stock. Overhead is also expected to be lowered by the elimination or reduction of sanding and grinding. Less dust during operation is anticipated.

The machine is available in widths from 26-50 inches, with the production of wider machines scheduled for the future.



Buss's Micro Surfacer for planing of abrasive and flexible materials

New Products

"Bashful Duffer Shield" Capped with Reinforced Polyester Panels

Polyester Roof for Golf Shield

For the benefit of novice golfers the San Diego Municipal Golf Course has erected a "bashful duffer shield" on its practice driving range. The shield consists of a three-sided semi-enclosure having a tubular steel superstructure, a surrounding frame of canvas, and a sun-shielding overhead roof of translucent fiberglas-reinforced plastic panels manufactured by Alsynite Co., of America. San Diego, Calif.

Hypalon Maintenance Coating

Atlas Hypalon Maintenance Coating, a flexible, self-curing chlorosulfonated polyethylene, has been introduced by Atlas Mineral Products Co., Mertztown, Pa. A specially compounded form of Du Pont's Hypalon, the coating is said to have excellent adhesive properties and resistance to weathering, heat, and corrosives.

No special primers are required for clean metal and concrete surfaces. Film thicknesses of 2-3 mils per coat can be obtained by brush, spray, or dip application. Each coat should be allowed to dry for at least two hours at 75° F. before recoating in order to avoid bubble formation from the trapped solvent. A minimum of three coats or five mils thickness is recommended for any type of service.

The coating will cure sufficiently in 24 hours to be placed in limited service, according to Atlas, but maximum cure requires 14 days at room temperature. This time can be reduced by the application of dry heat after the final coat has been allowed to dry for at least eight hours.

It is estimated that one gallon will produce a five-mil coating on 100 square feet of non-porous surface. The coating is sold in one-gallon cans, five-gallon pails, and 55-gallon drums. Standard colors include gray, black, and white.

Behr-cat Electrical Tape

A line of vinyl plastic-backed tape, whose physical and electrical properties qualify it for Underwriters' listing as an electrical insulating material, has been introduced by Behr-Manning Corp., Troy, N. Y. The new tapes are called Behr-cat 507, 510, and 520, and are 7, 10, and 20 mils thick, respectively.

The dielectric strength of over 1,000 volts per mil of thickness reputedly accounts for the superiority of the new tape over combinations of rubber and friction tapes for electrical applications. Fewer wraps are required, therefore affording less bulk, time, and labor.

The tapes can stretch at least 1½ times their length without breaking, and are resistant to abrasion and corrosion. The vinyl backing withstands acids, alkalies, water, salt water, and oils. Suggested uses include junction boxes, electrical harnesses, straight splices, refrigerator wiring, wrapping battery cables, ignition harnesses, and power cable splices. The tape can also be used in production electroplating, and for anodizing or wrapping subterranean pipe.

All three tape thicknesses are available in 36-yard rolls in a wide range of widths. Behr-cat No. 507, 7-mil tape, is also available in 20- and 66-foot rolls.

Splicing Vacuum Cleaner Wires with Behr-cat Plastic Tape

Boltaron Seamless 6200 PVC Valve

Seamless, Unplasticized PVC Valves

All-molded, seamless, unplasticized polyvinyl chloride valves have been introduced by H. N. Hartwell & Son, Inc., Boston, Mass., distributors of pipe, fittings, rods, blocks, sheets, and special fabrications, all sold under the Boltaron 6200 trademark, PVC materials manufactured by the Bolta Division of The General Tire & Rubber Co., Akron, O.

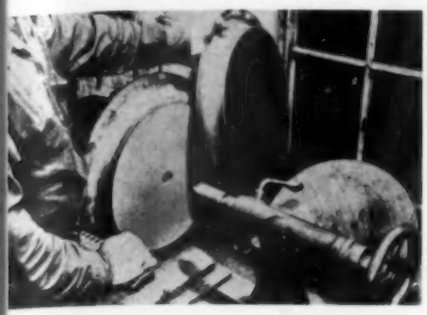
The new valves, available in one- and two-inch sizes, are the first of their kind designed and engineered by The Lunkenheimer Co., Cincinnati, O. Maximum service temperature is reported as 140° F., and working pressure as 125 pounds. Resistant to most industrial chemicals and reagents, the valves have high flow characteristics, will not rust or scale, and weigh about half as much as similar aluminum valves.

Featured is a streamlined body to reduce turbulence; a handwheel with rounded lugs to insure positive closing; a packing nut with easily tightened built-in gland; a stem that has large Acme threads and long engagement for rapid operation; packing made of self-lubricating Teflon; a generously-dimensioned bonnet that includes back-seating surfaces for easy repacking under full pressure; and a disc that swivels on the stem for self-centering action.

S-52 Laminated Die Stock

A laminated die stock which is said to produce economical metal spinning chucks and other froms for shaping ductile nonferrous metals, plastics, wood, and similar materials. Called S-52 Die Stock, this paper-base laminate impregnated with Bakelite phenolic resins is strong, easy to machine, and forms a smooth, dent resistant surface, according to the manufacturers, Formica Co., Cincinnati, O.

S-52 can be punched cold in thicknesses up to and including 3/64-inch, and hot punched in thicknesses through 3/32-inch. The stock is available in thicknesses from 1/32-3 inches, widths of 24, 30, and 36 inches, and lengths of 42, 60, 72, 84, and



Laminated plastic chuck used to spin steel ring.

96 inches. Intended for mechanical applications only, this grade is used in drill jigs, metal forming dies, aircraft tooling, automotive gauging, templates, and spinning chucks.

At Maryland Metal Spinning Co., Baltimore, Md., chucks formed of the new die stock are employed to form housings for delicate, precision made weather instruments. Brass 0.04-inch thick is spun to a tolerance of minus zero, plus 0.007-inch on a diameter of 3.409 inches, and the inside overall dimensions and tolerances run plus 0.005-inch, minus zero. A chuck 2¾ inches thick and 29¼ inches in outside overall diameter, is used to spin a 17-gage cold rolled steel ventilating ring with an inside flange 19½ inches in diameter for naval vessels.

Tinted Polyester Factory Panes

Color has been added to the fiberglass-reinforced polyester plastic factory window panes manufactured by Alsynite Co. of America, San Diego, Calif. According to the company's color researchers, the three scientifically-selected colors were each designed to solve a specific industrial daylighting problem.

Called Flat Panes, five standard sizes are available which reportedly can be cut with standard tools to fit other sizes of sash. Packed 50 to a carton, the 0.080-inch thick panes are said to be shatterproof and immune to cracking, crazing, warping, rot, and mildew. Alsynite claims that reduced installation and maintenance costs will save the average factory thousands of dollars over breakable glass glazing. The panes can be installed in either metal or wood frames like ordinary glass.

Flat Panes are made by impregnating fiberglass mat with colored polyester resins; the color being an integral part of each pane. The three available colors are listed as follows: Lite Rose, said to provide adequate diffused light to the gloomiest factory area, simultaneously offering a psychological lift by its cheerful hue; Cool Green, for correct lighting in very sunny plant areas; and Lite Blue, for high light transmission under normal factory conditions.

Installation of Alsynite Tinted Plastic Factory Glazing

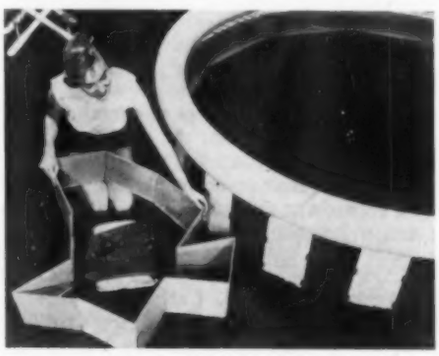
Expando-Accordion Wading Pool

A new type wading pool for children has been introduced by Holiday Line, Inc., New York, N. Y. Called Expando-Accordion Pool, it consists of a rigid frame of steel plates and a liner of PVC film with an inflatable rim.

Said to be an entirely new innovation, the steel plates, which are connected with metal hinges, fold accordion-style into a compact stack and open into a circular pool shape in a matter of seconds. The plates are made from heavy gage, cold-reduced sheet steel in lithographed panels of alternating colors, and can support weights up to 200 pounds.

The PVC plastic liner is made from two sheets of laminated and embossed Velon film, manufactured by Firestone Plastics Co., Pottstown, Pa. In addition to providing extra strength, laminating virtually precludes the possibility of pinpoint holes in the liner. A vacuum cleaner adapter is included for inflating the rim which acts as a seat and cushions a possible fall by the child.

The pools are currently being made in six sizes ranging from 51 inches to 12½ feet in diameter. Water drains of molded plastic are attached to all pools.



Holiday Line's New Wading Pool

OFF-F Scouring Pad

A new type scouring pad, reported to have three times the life of conventional pads, has been introduced by Gabriel Williams Co., Inc., Brooklyn, N. Y. Constructed of cellulose sponge with abrasives bound to its scouring surface by Geon vinyl plastic, the pads also have a sudsing detergent incorporated within the sponge.

Called OFF-F, the pads serve a variety of household purposes. Geon vinyl is supplied by B. F. Goodrich Chemical Co., Cleveland, O.

OFF-F Long Life Scouring Pad with Abrasive Held to the Surface by Geon Vinyl Plastic

Breakproof Plastic Labware

A line of polyethylene labware at prices reportedly comparable to those for glass, has been introduced by Pioneer Plastics, Dayton, O. Molded from Du Pont's Alathon 10 polyethylene resin, the labware is said to offer excellent resistance to corrosion and maximum stiffness over a wide temperature range.

Currently offered are a 250 ml. beaker with a sealing cover, a burette cover of up to 50 ml. capacity, and four 60° funnels. Previously considered a luxury item, it is expected that the plasticsware will find wide usage in schools and laboratories.

Polyethylene Labware: (l. to r.) Burette and Beaker Covers, Beaker, and Funnels

Plastic Table and Chair Legs

Newly designed Canadian dinette furniture features table and chair legs with molded sleeves of Tenite butyrate plastic over the regular steel-tubing framework. In addition to giving tapering lines and a durably lustrous surface, the butyrate sleeves are easy to clean and impervious to peeling and rusting.

Molded by Blaines Plastics Co., Ltd., St. Hyacinthe, P. Q., Canada, the sleeves are available in chipproof black, gray, or a woodgrain color effect.

Dinette Set Featuring Butyrate Plastic Legs

New Literature

"Cementing." Product Information Bulletin 1001. Monsanto Chemical Co., Springfield, Mass. 20 pages. This illustrated booklet describes techniques for cementing Lustrex molded styrene, clamping devices, classes of bonds, and joint design consideration, and gives a breakdown of cement types and tables for cement viscosity and setting time.

"Strip Heaters." Canadian General Electric Co., Ltd., Toronto, Ont., Canada. 4 pages. This folder describes properties, applications, specifications, insulation, and installation of G-E strip heaters.

"The Marblette Mirror." Special issue of quarterly news bulletin. Marblette Corp., Long Island City, N. Y. 4 pages. A complete, illustrated description of the vacuum forming process whereby a design is silk-screened onto a flat vinyl sheet, and the sheet vacuum formed on a phenolic die which has been cast and cured in a plaster mold.

"Screw-Type Extruding Machines." Bulletin 195. Farrel-Birmingham Co., Inc., Ansonia, Conn. 31 pages. Described and illustrated here are the company's plasticators, pelletizers, extruders, strainers, strainer-extruders, tubing machines, German mixers, and special-purpose machines for use in the rubber and plastics industries.

"Methods for Molding Reinforced Plastics." VB-18. Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. 24 pages. This illustrated booklet describes polyester molding techniques, chemical and physical properties of Vibrin resin 151, and suggested applications for Vibrin resins. Graphs of accelerated cure characteristics are also contained.

"Dow Corning 36 Emulsion." Silicone Notes, No. 5-108. Dow Corning Corp., Midland, Mich. 3 pages. Concerning a highly stable silicone mold lubricant for use with plastic, rubber, and cast metal parts, this publication lists typical properties of the material and reports its reaction to various physical and chemical stability tests.

"Exon 470." Firestone Plastics Co., Pottstown, Pa. 7 pages. Physical properties of this PVC resin and derived coatings are continued in this bulletin. Compatibility, solubility, and viscosity data are also given.

"Tumb-L-Matic Processes and Compounds for Tumbling Metal and Plastic Parts." Bulletin PC-55. Tumb-L-Matic, Inc., New York, N. Y. 2 pages. Wet and dry processes for cutting (wet ashing), smoothing, and lustering metal and plastic parts with Tumb-L-Matic compounds and carriers are described in this bulletin.

"Bakelite Vinyl Butyral Resins." Technical Release No. 11. Bakelite Co., division of Union Carbide & Carbon Corp., New York, N. Y. 26 pages. Physical properties, solubility and compatibility tables, and compounding properties of the resins are given. Applications as adhesives, wood finishes, cloth coatings, metal finishes, and wash primers for conditioning metal are described in detail.

"1955 Reference Guide." Dow Corning Corp., Midland, Mich. 8 pages. This latest edition of the company's catalog of its silicone products lists and describes 123 items, some only recently developed. Division is by application. Photographs of end items, property tables, and performance graphs are given.

"The ABC's of Spray Equipment." F-278. The DeVilbiss Co., Toledo, O. 64 pages. The third, revised edition of the company's spray painting manual has a question-and-answer format covering basic equipment for every phase of operation and maintenance. Written in non-technical language, it is intended for production line spray operators, automobile and furniture refinishers, maintenance painters, and commercial spray painters.

"Acetone." F-8650. Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. 11 pages. Applications, physical properties, specifications, shipping data, constant-boiling mixtures, six physical property charts, relative viscosity of lacquer formulations, general solvent properties, resin solubilities, and physiological properties are listed in this folder.

"The Technology Behind Investment." No. 2. Arthur D. Little, Inc., Cambridge, Mass. 27 pages. Three reviews of the chemical, plastics, and fertilizer industries by the economics staff of ADL industrial consulting service. The second article entitled, "The Plastics Industry," by John Walsh, gives seven pages of consumption statistics, major producers, and market predictions for each individual resin.

"Luncor Valves and Fittings." The Lunkenheimer Co., Cincinnati, O. 4 pages. This illustrated circular describes the firm's all-molded PVC valves and fittings for use with corrosive industrial chemicals.

"Plastoflex SP-2." Data Sheet 1254. Advance Solvents & Chemical Corp., New York, N. Y. 2 pages. These sheets list the physical properties of the plasticizer, and give suggested formulations and procedures for blowing and curing open-cell vinyl sponge.

"Strip Heaters." Canadian General Electric Co., Ltd., Toronto, Ont., Canada. 4 pages. This folder describes properties, applications, specifications, insulation, and installation of G-E strip heaters.

"40 Precision Finishing Operations." Bulletin No. 451-D. American Wheelabrator & Equipment Corp., Mishawaka, Ind. 18 pages. Forty specific industrial applications of the firm's wet abrasive blasting process for precision cleaning and finishing are described and illustrated in this booklet.

"15 Portraits in Print." Diamond Alkali Co., Cleveland, O. 16 pages. A collection of 15 of the company's advertisements, this booklet illustrates the applications of some of Diamond Alkali's chemical products.

"Thiokol Liquid Polymer Emulsions." Thiokol Chemical Corp., Trenton, N. J. 7 pages. This bulletin describes the preparation and curing of Thiokol water-based emulsions suitable as binders and impregnants for wood, paper, textiles, felt, and other water-absorptive materials; and as flexibilizers of water-dispersed phenolic, urea, and epoxy resins for coatings and adhesives.

"Richardson GGG-38 Multi-Purpose Bagging Scale." Data Sheet No. 5401. Richardson Scale Co., Clifton, N. J. 2 pages. Complete dimensions, specifications, and features are given in this illustrated data sheet.

"The Vacurator 50-100." Guy P. Harvey & Son Corp., Leominster, Mass. 12 pages. This manual describes, illustrates, and gives intsructions for the use of Vacurators-50, -100, Duo, and -Six, for making patterns, molds, and models. Step-by-step instructions are given for making die and mold cavities, die and mold cores and punches, metal slush or book molds, vulcanized rubber or metal shells, duplicate metal match plate patterns and machine master patterns, cast resin masters, tooling, and forming dies, and vacuum formed models and samples.

"Strainers for Oil, Water, Steam and Chemicals." Bulletin 9S. Schutte & Koerting Co., Bucks County, Pa. 16 pages. Dimensions, cross-sections, and descriptions of 15 of the company's strainers for high and low pressure service are reported in this booklet.

Book Reviews

"Plastics Engineering Handbook." The Society of the Plastics Industry, Inc. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 6 by 9¼ inches, 848 pages. Price, $15.00; special price to SPI members.

Compiled by over 200 authorities in the field, the second edition of the society's official handbook offers the most comprehensive data on plastics assembled in one reference volume. The text is divided into five sections: materials and processes, consisting of 11 chapters on material classifications and processing techniques; design, five chapters covering standards of tolerance and recommendations; finishing and assembly, three chapters on machining, decorating, cementing, welding, assembly, and gluing; testing, a section on methods of determining mechanical, thermal, and permanence properties; and a final section on voluntary commercial standards of the trade.

New features of this entirely rewritten edition include a chapter on production tooling with plastics, an expanded chapter on standards for tolerances of molded articles, and a fold-out adhesives chart for cementing and assembly. A subject index provides for handy reference by engineers, designers, shop foremen, fabricators, finishers, and a host of other plastics users.

"Fiberglas Reinforced Plastics." Ralph H. Sonneborn. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 5½ by 8½ inches, 252 pages. Price, $4.50.

Written for the design engineer, the reinforced plastics processor, and executives in the materials industries, this book covers in detail the resins and glass reinforcements used in reinforced plastics, as well as manufacturing techniques and secondary operations, inspection and testing, design considerations, and applications.

A chapter by A. G. H. Dietz discusses design theory and fundamental concepts of reinforced plastics in detail, and one by A. S. Heyser treats design from the strength, weight and economic aspects. The chapters on nature and uses, materials, and manufacturing processses are especially well illustrated with photographs and diagrams. Appendices include a glossary of terms bibliography, and a subject index. The comprehensive, up-to-date treatment of the field makes the book of great value to everyone concerned with reinforced plastics.

"The Technology of Solvents and Plasticizers." Arthur K. Doolittle. John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Cloth, 6 by 9 inches, 1056 pages. Price, $18.50.

Intended as a reference for workers in the fields of plastics, paints, varnishes, lacquers, adhesives, inks, and synthetic textiles, this comprehensive and apparently definitive tome combines both the theoretical and technological aspects of the subject. Also included are chapters on such commercially pertinent topics as the recovery, handling, storage, and shipping of the raw and finished products. Tabulations and charts report complete physical and chemical data on 161 solvents and 131 plasticizers available on the general market.

"Deterioration of Materials—Causes and Preventive Techniques." Edited by Glenn A. Greathouse and Carl J. Wessel. Reinhold Publishing Corp., 430 Park Ave., New York, N. Y. Cloth, 6 by 9 inches, 835 pages. Price, $12.00.

Prepared under the joint auspices of the Prevention of Deterioration Center, National Academy of Sciences, National Research Council and the Services Technical Committee of the U. S. Department of Defense, this book contains contributions by 24 specialists on the prevention of deterioration in such materials as rubber, plastics, metals, wood, paper, textiles, paint, and many others. The climatic, chemical, physical, and biological agents of deterioration are covered. Illustrations are plentiful, and there is a 1,500-item documentary reference index to the scientific literature.

"Monomeric Acrylic Esters." Edward H. Riddle. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 6 by 9 inches, 221 pages. Price, $5.00.

The first chapters of the book concern themselves with a history of acrylic monomers and polymers, including processes of preparation by the catalytic-stoichiometric reaction, the physical properties of commercially available acrylate and methacrylate esters, and methods for storing, handling, and removing the inhibitor from the monomer.

Subsequent chapters treat polymerization and copolymerization, both with other acrylic esters and with other resins such as vinyls, styrene, and polyesters. Reactions with active hydrogen compounds and with numerous other compounds, are described along with their use as intermediates in reactions other than polymerization. Analytical methods are listed for determining monomer purity. There is a four page bibliography, but no subject index. Data are up-to-date, and the latest theories of polymerization and copolymerization are emphasized.

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Abstracts of Important Articles

Materials

"The Effects of Fillers on PVC Plastisols," A. B. Rey and L. C. Jofra, *Rev. Plasticos,* 5, 28, 212 (July-Aug. 1954).

Description and results of tests to determine the effect of increasing amounts of kaolin and calcium carbonate in compounds of PCU-G (PVC produced by Chemische Werke Huls), on mechanical and electrical properties, and chemical resistance. (In Spanish).

"Nitrile Rubbers as Plasticizers for Polyvinyl Resins," W. E. Bolam, *Australian Plastics,* 10, 107, 18 (June 1954).

Properties and processing of nitrile rubber plasticizers are described with special reference to the advantages and limitations of blends with vinyl resins.

"Methods of Synthesis for the Production of Linear Polyamides from Furfural," K. Stickdorn, *Plaste Kautschuk,* 1, 8, 174 (Aug. 1954).

A review of methods. (In German).

"A Study on Ethylcellulose," P. Stuchlick, *Plastiques Informations,* (May 16, 1954).

The first of a series of studies on the chief plastics materials made in France. Gives a brief history, chemical composition, production, chemical and physical properties, and uses of each material. (In French).

"Recent Developments in P.V.C.," A. Iloff, *Plaste Kautschuk,* 1, 8, 178, (Aug. 1954).

Discussion chiefly of suspension or pearl polymerization of monomeric vinyl chloride, with special reference to development work at the Chemische Werke Buna in East Germany from 1949-1953. (In German).

"Wood Chips and Plastic Molding Compounds," E. J. Ritter, *Kunststoffe,* 44, 8, 329 (Aug. 1954).

Discussion of production and use of these materials including types of wood chips employed, plastic bonding agents, factory lay-out, and types of finished products. (In German).

"The Effect of Finishes on the Stickiness of PVC Leathers," H. E. Frey, *Kunststoffe,* 44, 8, 337 (Aug. 1954).

A method is described by which reproducible values are obtainable for determining stickiness (blocking effects) of various finishes at different temperatures. (In German).

"Reaction Method and Identification of Polyvinyl and Polyacrylic Compounds," H. Rath, *Kunststoffe,* 44, 8, 341 (Aug. 1954).

Reactions are described by which PVC and polyacrylic acid compounds can be clearly identified, even when only minute amounts of the substances are available for investigation. (In German).

"Contribution to the Study of Fractionation and Viscosity of Urea Formaldehyde Resins," R. E. Vogel, *Kunststoffe,* 44, 8, 335 (Aug. 1954).

Investigation of these resins is rendered extremely difficult by the presence of loose linkages. In an earlier work it had been shown that normal condensation processes govern the resin formation. In the present article, the structure is more clearly examined by fractionation and viscosity measurements. It is suggested that the urea-formaldehyde molecule has an oviform shape. (In German).

"Determination of the Synthetic Resin Binder Content in Flooring Compositions Based on Polyvinyl Acetate," E. Gollmer, *Kunststoffe,* 44, 9, 383 (Sept. 1954).

The process consists in saponifying the polyvinyl acetate, dissolving the resultant polyvinyl alcohol in water, and separating, drying and weighing the filler. The resin content is the difference between the weight of the original sample and the filler. (In German).

"The Physiological Effect of Plasticizers," E. Thinius, *Plaste Kautschuk,* 1, 9, 194 (Sept. 1954).

A discussion of the possible toxicity plasticizers for plastics intended for packing medicines, drugs, cosmetics, foods, etc. Classes of plasticizers reviewed include hydrocarbons, halogen-containing hydrocarbons, alcohols, ketones, and esters of inorganic and organic acids. Non-toxic plasticizers available for PVC include phthalic acid esters of octyl alcohols, butylphthalyl butylglycolate, a mixed ester of phosphoric acid from phenol and 2-ethyl-hexanol, and esters of sebacic acid and adipic acid. (In German).

"Polymerization and Flow of Polyesters," G. Fabre, *Ind. Plastiques Mod.,* 6, 8, 33 (Sept.-Oct. 1954).

The exothermic nature of polymerization was checked by measuring the temperature in the center of a cylindrical block. Polymerization was found to be increasingly retarded with decreasing amounts of catalyst. Tests of the effect on flow in traction of varying amounts of added styrene monomer showed that the greater the less marked the deformation, however, results depend on the freshness of the styrene. Fatigue tests on polyester-glass fiber materials yielded two curves, one above the other; the lower shows the damage limit and the upper the fatigue limit. Between these two limits, the reinforced plastic withstands repeated traction indefinitely, but it no longer has transversal rigidity. Before final rupture, the sample swells and becomes opaque, due to micro-ruptures in the resin. (In French).

Equipment

"Under 10,000 Pieces, Costs of Equipment Reduced 30-40%," E. Mailly, *Ind. Plastiques Mod. (Paris),* 6, 9, 34 (Nov. 1954).

Costs of molds for trial samples or small lots of plastic toys and other parts can be reduced by use of an alloy having properties approaching those of steel, but which can be cast at a very much lower temperature. (In French).

"Continuous Feeds for Sheet Calenders," E. Stoeckert, *Kunststoffe,* 44, 6, 231 (June 1954).

A comparison of machines for continuous preparation and feeding of the charge to sheet calenders. Discusses a gelatination band heater, consisting essentially of an infra-red tunnel through which passes a steel band spread with a paste of PVC, plasticizer, and other ingredients; a two-state "mixtruder"; and an Italian extruder described as a kind of multiple gear pump where the material passes through three pairs of herringbone gears and is subjected to both vertical and horizontal mixing action. (In German).

"Recent Development in Non-ferrous Mold-making," E. Kaldor, *Australian Plastics,* 10, 107, 39 (June 1954).

The advantages and limitations of electro-formed hard nickel dies and beryllium copper molds for plastics are briefly described.

"Problems of Steel Technology in Connection with the Cold Hobbing of Molding Tools for Plastics," G. Folke, *Kunststoffe,* 44, 9, 388 (Sept. 1954).

The effect of cold working on internal structure, strength, and toughness of steel, and the relation of quality to deformability are considered. The properties of matrix and plunger steel used in Sweden are discussed with special atteation to a special low-carbon, chrome-molybdenum steel. (In German).

"An Analytical Study of the Single Screw Extruder," C. Maillefer, *Brit. Plastics,* 27, 10, 394 (Oct. 1954) and 27, 11, 437 (Nov. 1954).

A theoretical study of the operation of single-screw extruders on viscous materials and dry powders. A general equation for output is developed in which use is made of the Navier-Stokes general equation for the movement of a viscous fluid. This equation has been verified by experiments with oil and with polyethylene, and the significant results are given in comparison with theoretical figures.

"Largest German Injection Molding Machine," H. Plum, *Kunststoffe*, 44, 8, 333 (Aug. 1954).

Construction of a new 3,150-gram (approximately seven pounds) machine, claimed to be the largest in Europe is described. (In German).

"High Capacity Injection Cylinder," H. Spies, *Plastverarbeiter*, 5, 10, 312 (Oct. 1954).

The capacity of an injection machine is increased considerably by the use of a new heating cylinder which, while retaining the dimensions of the former cylinder, has been provided with a much larger heating surface by means of 10 rib-like recesses. (In German).

"Molds and Apparatus for Processing Styropor," F. Stastny, *Plastverarbeiter*, 5, 9, 260 (Sept. 1954).

Descriptions are given of the various processing steps for the new expandable polystyrene block and bead material of Badische Anilin & Sodafabrik; the equipment required for sawing, turning, foaming, cutting, and slicing block Styropor; the apparatus for foaming Styropor beads to make various types of molded goods by hot air, hot water, and steam methods; and the subsequent treatment and finishing of the molded products. Waste utilization is also mentioned. (In German.)

"Mold Designs for Injection Machines," H. Gastrow, *Kunststoffe*, 44, 10, 481 (Oct. 1954).

Injection molds for long tubular parts have the plunger on the injection nozzle side, and external contours in the plugs. (In German).

"Electronic Welding of Plastics Materials," R. Paquet, *Digest Mat. Plastiques*, 9, 72, 23 (Sept.-Oct. 1954).

The principles of electronic welding and high frequency welding devices are briefly discussed; two Belgian machines are shown with separate and built-in HF generators, respectively. (In French).

Processing

"Decorating Plastic Sheet by the Screen-Printing Method," D. Jansen, *Plastverarbeiter*, 5, 8, 238 (Aug. 1954).

Non-technical, step-by-step explanation of small-scale application of screen printing. (In German).

"Multicolor-Printing on Plastic-Coated Fabrics and Plastic Films," I. Carlson, *Kunststoffe*, 44, 8, 367 (Aug. 1954).

The difficulties and possibilities of the rotogravure process, types of machinery, and problems common to all printing machines are discussed. (In German).

"Injection Molding Techniques for Polyethylene," F. Schaupp, *Kunststoffe*, 44, 8, 365 (Aug. 1954).

Details of the processing procedure for polyethylene are compared with those for other injection molding compounds such as polystyrene and plasticized cellulose acetate. (In German).

"Moldings from Wood Waste," E. J. Ritter, *Kunststoffe*, 44, 9, 378 (Sept. 1954).

Results of practical experience, collected by the Society of Molding Materials, are given in this article. The nature of the material, particularly its poor flow characteristics, presents various problems which must be taken into account in designing both products and molds. Processing is similar to that of phenolic molding compounds, and the same presses may be used. (In German).

"Cellophane and Machines for Making Cellophane Bags," H. Anders, *Plastverarbeiter*, 5, 8, 244 (Aug. 1954).

The development of cellophane for packaging, and methods of production in Germany are briefly reviewed with occasional reference to American practice. Three German machines are shown, of which one is equipped for printing in color. (In German).

"Production of Inexpensive Low-Pressure Molds by the Sprayed Metal Method," C. Mattson, *Kunststoffe*, 44, 10, 473 (Oct. 1954).

Metals alloys in wire form are sprayed from a pistol to provide a metal surface for cheap molds of wood, cement, plaster, and other materials for use in casting PVC, and in casting and vacuum forming polyester resins. Pre-treatment of molds and the building up of mold surfaces is also discussed. (In German).

"Compounding of PVC Pouring Pastes," J. Rowland, *Rubber & Plastics Age*, 35, 10, 493 (Oct. 1954).

Written from the practical viewpoint, this paper gives simple explanations of the physical factors involved in compounding the pastes, the physical state of the polymer during manufacture, standard compounding practices, and the effects of these factors on the paste in liquid form, pre-gelled state, and final cured condition.

"Design and Construction of Glass Fiber-Reinforced Plastics," F. Brockmoeller, *Kunststoffe*, 44, 10, 475 (Oct. 1954).

In order to use these new materials to the best advantage, their properties and peculiarities must be known and duly considered in design and processing. The relevant questions are treated from a practical viewpoint, and a table is given comparing their properties with those of steel and the light metals. (In German).

Applications

"Low Pressure Laminates," B. Hubert, *Plastiques Informations*, Nov. 1, 1954.

Interest in glass fiber-polyester resin laminates is growing in France. Various types of domestic polyesters are now on the French market, and one French firm has begun the production of fiber glass. The present paper describes basic materials, procedures, and applications. (In French).

"Synthetic Filter Cloth," W. L. Essed, *Plastica*, 7, 9, 428 (Sept. 1954).

The first of a series of articles on weaving patterns suitable for filler materials. The properties and uses of PVC filter cloth are given together with a list of the chemicals it resists. (In Dutch).

"Applications of Ethoxylene Resins," A. J. Wildschut, *Plastica*, 7, 8, 380 and 7, 9, 432 (Aug.-Sept. 1954).

The development of epoxy resins is reviewed with their most important applications: casting resins for embedding radio parts; adhesives; laminations; foams; and paints and lacquers. Also mentioned are the possibilities of new applications, particularly combinations with fiber glass. (In Dutch).

"The Function and Technology of Pressure-Sensitive Adhesives," H. Sonne, *Kunststoffe*, 44, 9, 385 (Sept. 1954).

The selection of suitable ingredients for producing pressure-sensitive adhesives is discussed, and the effects of different softeners, pigments, and solvents considered. In connection with the manufacture of adhesive tapes, various processing problems are discussed, including those relating to supports and unrolling. (In German).

"Use of Klegecell in Construction," *Plastiques Informations*, (May 16, 1954).

Discussion of the use of this extra lightweight cellular material for seals, vibration damping of machinery, insulation, and for acoustical and decorative purposes. (In French).

"Plastic Air Conduits in Mining," H. Kalpers, *Plastverarbeiter*, 5, 10, 316 (Oct. 1954).

Wide thermoplastic air conduits for air conditioning mines have been designed with metal rings or spiral wires welded (with the aid of plastic strips) onto the outside circumferences of the conduits so as to maintain the diameter in any position, and also provide a means of suspension. These conduits are also being used for ventilating purposes in chemical and other plants, and for suctioning off sawdust in woodworking plants. (In German).

"Nylon Bearings and Gears," J. F. Kohlwey, *Plastica*, 7, 7, 328 and 7, 8, 388 (July-Aug. 1954).

Review of the applications of nylon for these purposes, and discussion of the various factors that must be taken into account when using nylon. (In Dutch).

General

"The Terms 'Plastics' and 'Plastics Compounds' Considered with Special Reference to Lacquers," A. Greth, *Kunststoffe*, 44, 8, 327 (Aug. 1954).

Intermediates between the plastics raw material and the plastic material ready for conversion are the plastics compounds, a hitherto inadequately defined group. The nature of this class of materials, as exemplified by its quantitatively most important members, lacquers and varnishes, is examined with the aid of clarifying terminology and thinking with respect to development, applications, and economics. (In German).

Patent Digest

Materials

Joint Sealing Compounds Comprising a Vinyl Chloride-Vinyl Acetate Copolymer, Coal Digestion Pitch, and Tar Heavy Oil. No. 2,697,697. Harold R. Beck, Westfield, N. J., and Robert S. Detrick, Pittsburgh, Pa. (to Koppers Co., Inc., Pittsburgh, Pa.).

A jet fuel-resistant joint sealing composition consisting of 5-20% vinyl chloride-vinyl acetate copolymer, coal digestion pitch, and crystal-free tar fraction. The copolymer has an intrinsic viscosity in cyclohexanone of at least 1.1, and the final product has a cone penetration of 50-90 decimillimeters at 77° F.

Moisture Permeable Cellulose Acetate Composition. No. 2,697,046. John D. Bradner, Wilmington, Del. (to Atlas Powder Co., Wilmington, Del.).

A chemical composition consisting of a plasticizer and cellulose acetate, the plasticizer being about half monophenyl ether and comprising 10-35% of the total volume by weight.

Thermosetting Molding Compounds Comprising Bark Components. No. 2,697,-081. Clark C. Heritage, Tacoma, Wash. (to Weyerhaeuser Timber Co., Tacoma, Wash.).

A thermosetting molding resin consisting of the thermal reaction product of bast fiber and a phenol-formaldehyde in which the molar ratio of formaldehyde to phenol is greater than 1.4:1.

Adhesives Comprising Polyvinyl Ether. No. 2,697,084. Laszlo W. Eger, Metuchen, N. J. (to Permacel Tape Corp., New Brunswick, N. J.).

An adhesive containing 28.7-75% by weight solid polymer of vinyl alkyl ether which has an intrinsic viscosity from about 4-15, an age resistor, and a compatible tackifier 20-50% by weight.

Crystalline Vinylidene Chloride Copolymers. No. 2,697,091. Alfred S. Kidwell, Millford, Conn., and George P. Rowland, Jr., Pottstown, Pa. (to The Firestone Tire & Rubber Co., Akron, O.).

Vinyl Halide Polymers Plasticized with Dialkyl Monoaryl Phosphates. No. 2,694,-689. Harry R. Gamrath and Roger E. Hatton, St. Louis, Mo. (to Monsanto Chemical Co., St. Louis, Mo.).

The structural formula for the halide-ester linkage is outlined.

Chlorination of Ethylene Polymers. No. 2,695,899. Wilhelm Becker and Otto Bayer, Leverkusen-Bayerwerk, Germany (to Farbenfabriken Bayer Aktiengesellschaft. Leverkusen, Germany).

Mixtures of ethylene and vinyl compounds are emulsified by a water-soluble salt of sulfonated and sulfinated long-chain paraffin hydrocarbons and sulfonated fat alcohols. The resulting aqueous emulsion is immediately subjected to the action of chlorine until added chlorine is over about 40%.

Manufacture of Epoxide Resins. No. 2,694,694. Sylvan Owen Greenlee, Racine, Wis. (to Devoe & Raynolds Co., Louisville, Ky.).

A single-stage process is described for producing high melting point epoxide resins by heating under pressure in a closed vessel a chlorhydrin with a dihydric phenol in the presence of aqueous caustic alkali.

Manufacture of Perhalogenated Polymers under Controlled Conditions. No. 2,694,701. Oscar A. Blum, Bayonne, Albert L. Dittman, Jersey City, and John M. Wrightson, North Bergen, N. J. (to M. W. Kellogg Co., Jersey City, N. J.).

A process for the production of a polymer of trifluorochloroethylene in the presence of benzoyl peroxide as a catalyst and chloroform as a chain transfer solvent.

Adhesive or Molding Composition Comprising Brown Rotted Wood and Phenol-Formaldehyde Resin. No. 2,698,307. Clark C. Heritage, Minneapolis, Minn. (to Weyerhaeuser Timber Co., Longview, Wash.).

An adhesive composition consisting of an admixture of phenol-formaldehyde resin, a basic-reacting compound of an alkali metal, water, and brown rotted wood which has been formed by the action of a cellulose destroying fungus on standing timber.

Soluble Chloromethylated Polymers of Styrene and Alpha-Methyl Styrene, Their Quaternary Ammonium Salts, and Method of Making the Same. No. 2,694,702. Giffin D. Jones, Sanford, Mich. (to Dow Chemical Co., Midland, Mich.).

The formulation for a dioxane-soluble resinous composition is outlined.

Vinyl Chloride Polymers Plasticized with Trialkyl-1-Benzoylpropane-1,2,3 Tricarboxylates. No. 2,695,280. Joachim Dazzi, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

A resinous compound composed of a vinyl chloride polymer plasticized with a tricarboxylate is described with its empirical formula.

Epoxide Esters. No. 2,698,308. Samuel B. Crecelius, Washington, D. C. (to Devoe & Raynolds Co., Inc., Louisville, Ky.).

Organic carboxylic acid esters of resinous epoxide alcohols, which are polyether derivatives of dihydric phenols, are produced by heating them to alcoholysis temperature with organic carboxylic acid esters of readily volatile monohydric alcohols under high vacuum and in the presence of an alkaline catalyst. Selective esterification is effected by epoxide groups replacing hydroxyl groups.

Equipment

Apparatus for Advancing and Working Elastomer Compounds. No. 2,695,422. Alvin N. Gray, Edgewood, Md. (to Western Electric Co., Inc., New York, N. Y.).

An extruder having a cylinder with two feed openings, and two stock screws mounted concentrically. The outer screw has threads extending along one of the cylinder openings, and blades extending through the stock screw along the other opening. The inner screw has threads extending along the slots in the outer screw.

Injection Cylinder for Molding Machines. No. 2,696,641. William H. Schwartz, Cleveland, O. (to Lester Engineering Co., Cleveland, O.).

A spreader with a longitudinally extending central bore, open at the head end to accommodate an electric heating element and leads, is clamped between an injection cylinder body and a base to form an annular passage for the flow of molding material. Cylindrical walls, coaxial with the bore, terminate in a circular cross-section opening, located radially outward. The molding material flowing through the annular passage is progressively transformed from annular to rod-like form, and is extruded through a circular opening in the base.

Continuous Mixing Mill for Plastic Materials. No. 2,696,635. James Rehak, Cicero, Ill., Clifford R. Wallace, Paris, and Rex C. Seanor, Akron, O. (to Adamson-United Co., Akron, O.).

A plate-like casement of arcuate contour, having a plurality of bores extending in the direction of the arc, surrounds a helically grooved roll which is journaled with a smooth mill roll on a base to form a bight. Edge portions of the casement are removed to connect ends of adjacent bores, and cover plates are secured to seal over the connections between the bores.

Apparatus and a Method for Extruding and Drying Plastic Materials. No. 2,696,-639. Alfred W. Meyer and Peter C. Firing, Matawan, and Kenneth W. Pratt, Fords, N. J. (to National Lead Co., New York, N. Y.).

An apparatus consisting of a chute with an integral perforated bottom, a vibrator which expels material through the perforations in the chute, and a conveyor belt which carries the extruded material in the form of self-sustaining strings of unbroken lengths through a dryer.

Extrusion Device. No. 2,696,640. Michael Wienand, Siegburg, district of Koln, Germany. (to Dynamit Actien-Gesellschaft vormals Alfred Nobel & Co., Troisdorf, Germany).

A die with a plurality of spaced extrusion conduits extending in an extruding direction which widen toward the outlets and narrow at the elongated nozzle slot, combined with an elongated pressure chamber which gradually constricts to the nozzle slot, thereby forcing bands of plastic material to enter the conduits and be extruded as foil.

Method and Apparatus for Treating Plastic Web. No. 2,697,851. John D. Haskell, Fulton, N. Y. (to Black-Clawson Co., Hamilton, O.).

Large diameter drums are used to convey and cool belts of hot plastic film in a continuous operation. This eliminates the need for a cooling bath.

Process and Apparatus for Making Elongated Bars, Blocks, and the Like. No. 2,697,854. Edouard Hein Boasson, Arnhem, and Jan Lodewijk Voigt, Ede, Netherlands. (to N. V. Onderzoekingsinstituut Research, Arnhem, Netherlands.).

A preheated elongated mold is filled with molten synthetic polyamides or the like having a narrow melting range. The material is cooled progressively, and the excess diverted through feed openings to a similar mold at a predetermined constant pressure, thus compensating for shrinkage during cooling.

Processing

Method of Making Sintered Nylon Articles and Resultant Product. No. 2,695,425. Louis L. Stott, Reading, Pa. (to Polymer Corp., Reading, Pa.).

A shaped polyamide article is formed by cold compressing heavy linear polyamides in a mold, and sintering by heating under oxygen-free conditions above the inflection point temperature, but below the melting point.

Method of Making Cellular Products from Vinylidene Chloride Copolymers. No. 2,695,427. Theodore W. Sarge and Frank H. Justin, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Forming of a powdered mixture of alkali metal bicarbonate and a copolymer mixture of vinylidene and vinyl chloride which is then subjected to a radio-frequency field until the mixture reaches the softening point. The resultant foamed product is removed before charring.

Method for Forming High Acetyl Content Cellulose Acetate Sheets into Shaped Articles. No. 2,694,227. Charles R. Fordyce and David R. Simonsen, Rochester, N. Y. (to Eastman Kodak Co., Rochester, N. Y.).

A method of molding a thermoplastic sheet of plasticized cellulose acetate and by heating the sheet to plasticity in a flat plane and drawing it into a mold by suction in a continuous operation.

Process for Making Rough Surfaced Filaments. No. 2,695,835. Weston Andrew Hare, Augusta County, Va. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Rough surfaced filaments of synthetic polymers are produced by spinning a melted plasticized polymer, removing the surface plasticizer by volatilization, cold drawing the resultant filaments to obtain a rough exterior, and removing the remaining plasticizer.

Methods of Producing Plastic Adhesive Sheets. No. 2,695,251. Willard M. Bright, Chicago, Ill. (to Kensall Co., Boston, Mass.).

An adhesive material is dissolved in a volatile, halogenated hydrocarbon solvent and applied to a film consisting of a solid ethenoid which is insoluble in hydrocarbons. The temperature is then raised above the threshold of solubility of the ethenoid polymer and the solvent driven off.

Manufacture of Transformers. No. 2,697,855. Robert R. Brown, Union, N. J. (to Elastic Stop Nut Corp. of America, Union, N. J.).

In the manufacture of transformer units having a molded casing which requires subsequent curing, the core and windings are placed in the mold cavity and curing is enacted by passing current through at a higher cycle frequency than that for which the winding is designed.

Method for Joining Thermoplastic Sheet Material. No. 2,698,273. Samuel S. Miner and Edward H. Clark, Mishawaka, Ind. (to United States Rubber Co., New York, N. Y.).

Two surfaces of thermoplastic sheet material are lapped and heated to form an integral joint, keeping the areas adjacent to the joint at temperatures below the melting point.

Method of Making Mat of Glass Fibers. No. 2,697,056. Ralph E. Schwartz, Hollywood, Calif. (to Vibradamp Corp., Los Angeles, Calif.).

Solid glass is melted and flowed through a die to form primary glass fibers which are then exposed to hot gas for conversion into secondary fibers. These fibers are sprayed with water and thermosetting resin binder, and heated sufficiently to cause matting, but not enough to cure the resin.

Pressure - Tight Metal - to - Polyethylene Seal. No. 2,697,058. Frank J. Lasak, Schenectady, N. Y. (to General Electric Co., Schenectady, N. Y.).

Polyethylene flame-sprayed onto a metal surface which has been heated to 200-250° C., thereby imbedding polyethylene particles into the softened metal. The polyethylene member is then pressed to the metal at its (the plastic's) softening point temperature. Cooling completes the bond.

Method of Coating a Sheet of Polyvinyl Butyral Resin and Laminating Said Sheet between Glass Plates. No. 2,697,053. Gelu S. Stamatoff, Newark, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Both surfaces of an interlayer sheet of polyvinyl butyral resin are coated with polyvinyl butyral dissolved in ethanol, water droplets impinging on the surfaces due to the water-insoluble plasticizer used with the resins. The sheet is soaked in water until the ethanol is leached away and the roughened surface hardened. After drying the embossed sheet is laminated between glass plates.

Method and Apparatus for Winding Collapsible Tubing. No. 2,697,852. James Bailey, West Hartford, Conn. (to Plax Corp., West Hartford, Conn.).

An apparatus for collapsing and gathering tubing of thermoplastic material which varies in thickness. Includes a means for collapsing the tubing, a roll for winding the collapsed portion, and a means for rotating the uncollapsed portion relative to the collapsed portion.

Method for Producing Cellular Thermoplastic Bodies. No. 2,697,255. Herbert Lindemann, Sins, Switzerland.

A completely expanded, closed cell type, gas-containing thermoplastic resin is sliced and heated above the heat distortion temperature, but below the softening point, until some of the gas diffuses into the surrounding atmosphere. This causes the cellular body to contract and form a dimensionally-stable closed cell with an increased specific gravity.

Method of Molding Articles from Plastic Materials. No. 2,696,023. Louis L. Stott, Reading, Pa. (to Polymer Corp., Reading, Pa.).

Elongated pieces of synthetic linear polyamides may be formed by introducing molten polyamide into an elongated mold, which has been pre-heated to a temperature just below the melting point of the compound. The resin is compressed and cooled slowly to produce a gradual solidification.

Applications

Aluminum Based Laminate Member and Process for Producing the Same. No. 2,694,028. Christian J. Rapp. Hampton, S. C. (to Westinghouse Electric Corp., East Pittsburgh, Pa.).

A composite laminated member composed of an aluminum body sheet, a fibrous face laminate, and a binder sheet disposed between them and adhered to the aluminum by means of a thermosetting resin.

Interlocking Wall Tile. No. 2,693,102. Carl J. Luster, Cambridge, O., and Richard G. Brown, Wilkinsburg, Pa. (to Pittsburgh Plastic Products, Inc., Carnegie, Pa.

An ornamental wall tile is described as having laterally protruding interlock slots and tabs, thereby providing an uninterrupted overlap.

Domestic Production and Sales of Plastics and Resin Material, September and October, 1954

Following are the revised, final September figures and the preliminary, estimated Ocotober 1954 statistics for domestic production and sale of plastics and resinous materials. Units listed are in pounds, dry basis unless otherwise specified.

Based on previous months' tabulations, there appears to be a slight upward trend for thermosetting bonding and adhesive resins, vinyls, and miscellaneous synthetic plastics and resin materials. Data on alkyds and rosin modifications have not been included as their use is primarily limited to the protective coating industry.

	SEPTEMBER		OCTOBER	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,774,922	1,737,388	1,370,770	1,344,848
Sheets, 0.003 gage and over	1,053,087	1,241,892	1,166,619	1,153,447
All other sheets, rods, and tubes	602,123	580,384	536,689	450,761
Molding and extrusion materials	7,839,615	7,761,198	7,520,059	7,899,755
Nitrocellulose sheets, rods, and tubes	362,489	468,479	332,185	299,802
Other cellulose plastics	585,904	500,231	415,558	469,693
TOTAL	12,218,140	12,289,572	11,341,880	11,618,306
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	15,686,286	15,419,927	15,050,373	14,596,005
Bonding and adhesive resins for—				
Laminating (except plywood)	5,408,404	3,931,281	5,944,258	3,852,064
Coated and bonded abrasives	953,296	1,025,179	985,573	973,017
Friction materials (brake linings, clutch facings, and similar materials)	1,278,538	1,352,616	1,495,501	1,296,325
Thermal insulation (fiber glass, rock wool)	3,301,138	3,385,237	3,150,282	3,270,647
Plywood	3,184,656	3,011,566	3,109,967	2,865,856
All other bonding and adhesive uses	1,057,792	1,059,560	1,182,777	1,209,509
Protective-coating resins, unmodified and modified except by rosin	2,171,490	1,789,221	1,993,906	1,526,403
Resins for all other uses	2,649,176	2,243,587	2,138,295	2,422,872
TOTAL	35,690,776	33,218,174	35,050,932	32,012,698
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,934,280	2,772,941	2,899,587	2,849,389
Paper-treating and paper-coating resins	1,707,000	1,992,783	2,433,320	1,872,071
Bonding and adhesive resins for—				
Plywood	7,451,773	6,984,172	7,123,204	7,071,027
All other bonding and adhesive uses, including laminating	2,174,110	2,528,698	2,476,281	2,013,904
Protective-coating resins, straight and modified	2,504,523	1,977,634	2,613,177	1,827,637
Resins for all other uses, including molding	5,320,985	5,417,794	6,199,356	5,801,216
TOTAL	22,092,671	21,674,022	23,744,925	21,435,244
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for—				
Film (resin content)	....	5,664,779	....	5,427,106
Sheeting (resin content)	....	4,340,151	....	4,226,742
Molding and extrusion (resin content)	....	13,454,339	....	13,456,189
Textile and paper treating and coating (resin content)[3]	....	3,784,238	....	3,889,659
Flooring (resin content)	....	3,797,141	....	3,688,206
Protective coatings (resin content)	....	2,241,990	....	2,198,369
All other uses (resin content)	....	3,788,755	....	3,515,048
All other vinyl resins for—				
Adhesives (resin content)	....	2,379,392	....	2,215,227
All other uses (resin content)	....	5,768,022	....	6,764,786
TOTAL	44,388,978	45,208,807	48,969,787	45,381,332
Styrene Resins:				
Molding materials[1]	30,502,264	27,142,089	31,592,764	27,700,072
Protective-coating resins, straight and modified	6,273,822	6,155,471	6,763,759	6,341,686
Resins for all other uses	6,849,588	5,951,981	7,603,439	6,453,360
TOTAL	43,625,674	39,249,541	45,959,962	40,495,118
Coumarone-Indene and Petroleum Polymer Resins	20,268,386	20,615,677	18,424,549	18,239,872
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1] [4]	16,074,965	16,891,951	19,573,015	16,383,281
Protective-coating resins[5]	419,112	324,651	724,234	330,315
Resins for all other uses[6]	11,697,998	12,441,076	13,097,813	13,522,068
TOTAL	28,192,075	29,657,678	33,395,062	30,235,664
GRAND TOTALS	206,476,700	201,913,471	216,887,097	199,418,234

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, polyethylene, nylon, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
SOURCE: United States Tariff Commission, Chemical Division.

Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear quarterly, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

— The Editor

Adhesives

CD Cement Nos. 200, 201, 202, 203, 204	gl.	$0.94 /	$1.50
PS-7	gl.	2.12 /	2.90
G-E 12316	lb.	.2975/	.3975
Metlbond 2002-14	gl.	1.84 /	5.00
4021 Type I	sq. ft.	1.43	
Type II	gl.	1.29 /	3.20
Type III	gl.	1.49 /	3.50
Plaskon Phenolic Bonding Resin	lb.	.16 /	.21
Urea Adhesive 530-11L	lb.	.1875/	.2175
Liquid Adhesive, 2L Types	lb.	.105 /	.115
WR Types	lb.	.0675/	.125
Spray Dried Adhesives	lb.	.18 /	.29
Schenectady SP-7401	lb.	.29 /	.31
Schwartz Vinyl Cement	gl.	1.24 /	1.50

Anti-Static Agents

Anstac-2M	gl.	1.75 /	2.00
Logostat	gal.	1.35 /	1.65
Merix Anti-Static	gl.	1.60 /	4.00

Catalysts

Cadet benzoyl peroxide, granules	lb.	.98 /	1.13
Paste	lb.	.95 /	1.35
Powder	lb.	1.50	
Dichlorobenzoyl peroxide	lb.	4.50 /	4.95
Lauroyl peroxide	lb.	1.90 /	2.30
Methyl ethyl ketone peroxide	lb.	1.85 /	2.50
Curing Agent 105	lb.	2.00 /	2.25
A	lb.	3.00 /	6.75
D	lb.	3.00 /	4.75
Furane H-736-A	lb.	1.30 /	2.00
Hardener 157	lb.	1.00 /	1.15
175, 179, 191	lb.	.50 /	.65
342	lb.	1.40 /	1.55
HN 551	lb.	.95 /	1.40
901	lb.	.36 /	1.80
951 Ciba	lb.	.62 /	2.37
951 Furane	lb.	1.30 /	2.00
Plaskon Hardeners, Liquid	lb.	.07	
Powdered	lb.	.10 /	.46
Spray dried	lb.	.10 /	.25
Promoter D-2	lb.	1.60 /	2.00
Shell ditertiary butyl peroxide	lb.	1.965 /	2.92

Coating Resins

CD Strip A	gl.	1.13 /	2.10
Kel-F Dispersion (dry wt.)	lb.	12.00	
Plaskon Alkyds	lb.	.1075/	.3375
Modified	lb.	.15 /	.2625
Ester Gums	lb.	.1425/	.2475
Maleics	lb.	.1825/	.275
Melamines	lb.	.195 /	.435
Phenolics	lb.	.3925/	.475
Modified	lb.	.1825/	.29
Phenolic Laminating Varnishes	lb.	.165 /	.27
Silicone Alkyds	lb.	1.10 /	2.40
Ureas	lb.	.195 /	.435
Schenectady Alkyds SA Type	lb.	.3575/	.38
SE Type	lb.	.3675/	1.435
SEA Type	lb.	.3575/	.38
Styrenated	lb.	.22 /	.2625
Maleics	lb.	.1725/	.23
Phenolics	lb.	.2325/	.53
Modified	lb.	.1825/	.275
Schwartz AT-25	gl.	.63 /	1.00
BE-40	gal.	3.80 /	3.95

Colors

Cabot carbon blacks	lb.	.05 /	.79
Cadmolith Reds	lb.	1.72 /	2.20
Yellows	lb.	1.12 /	1.20
Ferro blues, browns, greens	lb.	.90 /	2.96
Reds	lb.	2.93 /	4.75
Yellows	lb.	.91 /	2.90
Kentucky inorganics, orange	lb.	.44 /	.64
Yellows	lb.	.31 /	.66
Organics, blues	lb.	3.00 /	4.15
Greens	lb.	3.50 /	4.60
Purple	lb.	1.85 /	2.05
Reds	lb.	1.95 /	3.85
Kralastic standard colors	lb.	.50 /	1.10
Kriegr-O-Dip W Types	gl.	2.63 /	7.80
A Types	gl.	1.52 /	2.25
Mearlmaid Pearls	lb.	14.00 /	25.00
Nacromer Pearls, Series C	lb.	2.15 /	2.25
Series W	lb.	1.50 /	1.60
PMS polyester colors	lb.	.85 /	2.85
Polystyrene colors	lb.	.65 /	4.30
Polysupra polyethylene blues	lb.	.65 /	5.60
Blacks	lb.	.50 /	.80
Browns	lb.	1.48 /	3.30
Greens	lb.	1.82 /	3.55
Ivory	lb.	.65 /	1.00
Purples	lb.	2.10 /	3.30
Reds	lb.	.70 /	6.30
Silver	lb.	1.50 /	2.95
White	lb.	.60 /	.85
Yellow	lb.	1.45 /	4.25
Polystyrene blues	lb.	.50 /	9.20
Blacks	lb.	.50 /	5.30
Browns	lb.	.95 /	2.55
Greens	lb.	.35 /	7.40
Ivory	lb.	.85 /	1.20
Reds	lb.	.35 /	6.40
White	lb.	.60 /	1.05
Yellows	lb.	1.45 /	2.95
R-C blacks	lb.	5.50 /	21.30
Browns	lb.	4.375 /	15.75
Reds	lb.	.28 /	15.05
Yellows	lb.	3.60 /	14.05
Res-N-Dye (dry wt.)	lb.	7.50	
Saran colors	lb.	.59 /	1.80
Violite 199, green	lb.	2.95	
200, yellow	lb.	3.75	
PL 3–60, blue	lb.	3.25	
18–70, blue	lb.	3.70	
Witcoblaks	lb.	.075 /	.37
Zopaque, anatase	lb.	.225 /	.235
Rutile	lb.	.245 /	.255

Dispersing Agents

Daxads	lb.	.08 /	.40

Fillers

Cab-o-sil	lb.	.81 /	.87
Calcene NC	lb.	.036 /	.059
TM	lb.	.0375/	.0625
Cotton flocks	lb.	.12 /	.32
Hi-Sil 101	lb.	.10 /	.155
233	lb.	.09 /	.105
Kalite	ton	50.00 /	65.00
Multifex MM	ton	110.00 /	125.00
Silene EF	lb.	.06 /	.105
Surfex MM	ton	37.00 /	52.00
Suspenso	ton	33.00 /	48.00
Witcarb P	ton	110.00 /	140.00
R	ton	120.00 /	150.00
Regular	ton	56.75 /	85.00
Wollastonite F-1	ton	23.00 /	25.00
P-1	ton	25.00 /	27.00

Finishes

Toy Gloss T-11 H.	gal.	2.75 /	4.45
Logoquant colors	gal.	3.35 /	11.95
Silk screens	gal.	1.50 /	6.11
Logoset Series W	gal.	1.72 /	7.64

Flame-Proofing Agents

M&T Antimony Oxide	lb.	.29 /	.305
Flame Retarder	lb.	.29 /	.305

Lubricants

Baselube	gl.	2.50 /	4.00
Bomb-Lube	lb.	1.35 /	1.95
DC-36 Emulsion	lb.	1.36 /	2.50
Lunn-Lease	gal.	4.15 /	4.85
Metasap barium stearate	lb.	.37 /	.42
Calcium 627	lb.	.36 /	.41
Stearate	lb.	.35 /	.40
Magnesium stearate	lb.	.38 /	.43
Mold-Ease Concentrate PCR	gl.	2.50 /	5.85
Partingkote No. 823	gl.	1.18 /	4.36
Prepoxy No. 832 A	gl.	2.85 /	3.00
Plastik Parting Fluid No. 829	gl.	2.18	
Releasor Wax No. 826	lb.	2.29	
SS-452	gal.	2.80 /	4.90
Toplube	gl.	2.50 /	4.00
Vibrin-VPA Parting Agent	gal.	4.25 /	4.65

Miscellaneous

Metasap Water Proofing Agent 569	lb.	.21	
PMS Purging Compound	lb.	.35	

Molding Compounds & Resins

Acrylic

Lucite injection molding powders:			
Colorless, transparent	lb.	.68 /	.80
Std. colors	lb.	.72 /	1.00
Compression molding powders	lb.	.65 /	.75
Plexiglas molding powders:			
Colorless	lb.	.68 /	.835
Colors, std.	lb.	.72 /	1.035
Stock	lb.	.72 /	.885
Sheets, Types I-A & II			
Colorless	sq. ft.	.80 /	43.61
Colored	sq. ft.	.88 /	1.82
Type R: colorless	sq. ft.	.76 /	1.16
Colored	sq. ft.	.87 /	1.33

Alkyd

Plaskon foundry resin 580-11L	lb.	.245 /	.275
Molding compound, Type 411	lb.	.43 /	.60
Type 413, 417	lb.	.57 /	.74
Type 420 black	lb.	.44 /	.695
Type 422 colored	lb.	.51 /	.695
Mottle	lb.	.52 /	.705
Natural	lb.	.49 /	.60
Type 430	lb.	.34 /	.50

Cellulosic

Cellulose acetate:			
Ampacet Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III			
Colors	lb.	.50 /	.59
Metallic	lb.	.63 /	.71
Pearl	lb.	.59 /	.68
Phosphorescent	lb.	.80 /	.89
Celanese film rolls			
Clear	lb.	.64 /	.87
Colors	lb.	.88 /	1.74
Sheets			
Clear	M. sq. in.	.032 /	.107
Colors	M. sq. in.	.042 /	.141
Lumarith molding cmpds.,			
Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III	lb.	.42 /	.51
Sheeting, extruded, non-stock			
Clear	lb.	.12 /	1.89
Colors	lb.	.15 /	2.07
Stock, clear	M. sq. in.	.12 /	1.62
Colors	M. sq. in.	.14 /	1.62
Cast, rolls			
Clear	M. sq. in.	.125 /	.558
Matte	M. sq. in.	.179 /	.648
Tinted	M. sq. in.	.239 /	.708
Sheets, clear	M. sq. in.	.141 /	1.52
Matte	M. sq. in.	.203 /	.788
Tinted	M. sq. in.	.253 /	1.72
Hercocel A, extrusion & injection	lb.	.50 /	.65
Injection, std. colors	lb.	.46 /	.61
Special colors	lb.	.42 /	.45
Tenite Acetate, Group 1	lb.	.50 /	.59
Group 2	lb.	.46 /	.55
Group 3	lb.	.41 /	.51
Group 4	lb.	.38 /	.49
Group 5	lb.	.65 /	.75
Cellulose acetate butyrate:			
Tenite butyrate	lb.	.62 /	.71
A pearls	lb.	.72 /	.81
Blacks, reprocessed	lb.	.50 /	.58
Ethyl cellulose:			
Dyeform 720, 721	lb.	1.29 /	1.52
Ethocel P. G.	lb.	.72 /	.80

Bulk, reg.	lb.	.66 /	.81
Std., 7 cps.	lb.	.71 /	.86
Hercocel E	lb.	.72 /	.88

Epoxy

Araldite 502, 504, 6020, 6030	lb.	.905 /	1.51
551	lb.	.75 /	1.20
552	lb.	.72 /	1.22
6060	lb.	.75 /	1.20
Epocast 2, 3, 5	lb.	1.33 /	1.77
4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste	lb.	1.15 /	1.55
Epon 828	lb.	.80 /	1.21
834	lb.	.90 /	1.56
864	lb.	.91 /	1.44
864-C-75	lb.	.73 /	.74
1001	lb.	.615 /	1.56
Furane CN-502	lb.	1.33 /	1.77
Jet-Kote (with cat.)	gal.	7.50 /	10.00
Rezolin L-900	lb.	1.33 /	2.19
L-910	lb.	1.42 /	2.19
L-930	lb.	1.51 /	2.19
L-940, -941, -942	lb.	1.52 /	2.19

Fluorocarbon

Kel-F Grade 270, 300			
High density	lb.	9.00 /	10.00
Low density	lb.	8.50 /	9.50
Grade 300-P25	lb.	10.00 /	11.00
Polyfluoron granules, high density	lb.	9.00 /	10.00
Powder, low density	lb.	8.50 /	9.50
Dispersion grade	lb.	10.50 /	11.50
Teflon powder, dispersion	lb.	7.00 /	7.75
Fine	lb.	9.50 /	11.00
General	lb.	5.10 /	5.75
Tape cylinder	lb.	5.35 /	6.00

Melamine

Fiberite 2016	lb.	.95	
Plaskon	lb.	.44 /	.75

Phenolic

Admirez PL-50	lb.	.215	
UP-11	lb.	.2325	
Bakelite general purpose	lb.	.187 /	.3525
Barrett foundry resins, liquid	lb.	.2125/	.2425
Powdered	lb.	.27 /	.355
Insulation resins	lb.	.15 /	.175
Molding resin 313, 314, 317	lb.	.27 /	.285
316	lb.	.295 /	.31
1502, -3, -4, -5, R-110R	lb.	.25 /	.265
R-114	lb.	.285 /	.30
Corfoam 107, 114	lb.	.55 /	.82
Durez, heat resist.	lb.	.19 /	.245
Impact resist.	lb.	.24 /	.63
Insulation	lb.	.21 /	.305
Non-Bleed	lb.	.19 /	.195
Special	lb.	.19 /	.665
Std.	lb.	.19 /	.245
Durite GP	lb.	.195 /	.24
HR	lb.	.191 /	.3025
IM	lb.	.24 /	.415
SG	lb.	.195 /	.3575
Fiberite 1078	lb.	.42 /	.43
1087, 1165, 1270, 1271, 1330, 1332, 1347, FM 1132, FM 3510	lb.	.39 /	.395
1153	lb.	.455 /	.46
1167	lb.	.3875/	.3925
1340	lb.	.4275/	.4325
1346	lb.	.44 /	.4475
4010	lb.	.68	
4020	lb.	.815 /	.82
FM 926	lb.	.43 /	.435
927	lb.	.41 /	.415
1914	lb.	.375 /	.38
1957	lb.	.445 /	.45
1996	lb.	.375 /	.38
10365	lb.	.5225/	.5275
11547	lb.	1.05 /	1.06
11678	lb.	.52 /	.525
14111	lb.	.415 /	.42
17067	lb.	.851 /	.82
17610	lb.	1.05 /	1.06
G-E 12316 foundry resin	lb.	.2975/	.3975
12368, 12374, 12392 shell mold	lb.	.26 /	.36
12408, 12460, 12490, 12491, 12493, 12853, 12863, 12875, 12460	lb.	.19 /	.20
12420, 12439	lb.	1.05 /	1.15
12430, 12817, 12882	lb.	.20 /	.21
12432	lb.	.39 /	.395
12433	lb.	.55 /	.555
12435	lb.	.235 /	.24
12439, 12466	lb.	.26 /	.36
12444	lb.	.42 /	.425
12462	lb.	.50 /	.505
12463	lb.	.40 /	.405
12467	lb.	.50 /	.60
12486	lb.	.195 /	.20
12487, 12489 rubber-phenolic	lb.	.355 /	.36
12494 rubber-phenolic	lb.	.375 /	.38
12495	lb.	.24 /	.245
12808 rubber-phenolic	lb.	.49 /	.495
12809 rubber-phenolic	lb.	.65 /	.655
12824	lb.	.49 /	.495
12841	lb.	.2375/	.2425
Loven LHR-401, -403	lb.	.225 /	.23
-407, -409	lb.	.60 /	1.00
-408	lb.	.25 /	.255
LI-201	lb.	.39 /	.40
-207	lb.	.475 /	.48
-209	lb.	.60 /	1.00
-212	lb.	.425 /	.43
LM-110, -119	lb.	.19 /	.195
-101	lb.	.24 /	.245
-116	lb.	.255 /	.26
-117	lb.	.225 /	.23
-118	lb.	.1975/	.2025
LMI-301	lb.	.2525/	.2575
-303	lb.	.345 /	.35
-304	lb.	.60 /	1.00
-307	lb.	.3075/	.3125
MM-801, -803	lb.	.2125/	.2175
-804, -811	lb.	.245 /	.25
-807	lb.	.215 /	.22
Marbelette casting resins	lb.	.50 /	.60
Plenco foundry resins	lb.	.27 /	.35
Molding cmpds., gen purpose	lb.	.185 /	.235
Heat resist.	lb.	.19 /	.24
Improved impact	lb.	.225 /	.28
Min. bleed	lb.	.185 /	.195
Radio & TV	lb.	.20 /	.215
Stock	lb.	.205 /	.34
Resinox, gen. purpose, heat resist	lb.	.19 /	.20
Impact	lb.	.245 /	.3125
Low elec. loss	lb.	.30 /	.355
Special	lb.	.20 /	.24
Rogers RX-425	lb.	.28 /	.385
-426	lb.	.3425/	.3475
-428	lb.	.34 /	.455
-429	lb.	.35 /	.46
-431	lb.	.4075/	.53
-442	lb.	.3325/	.3375
-448	lb.	.34 /	.345
-458	lb.	.365 /	.37
-525	lb.	.28 /	.285
Schenectady shell mold resins	lb.	.26 /	.28
Toolplastik No. 8000	lb.	.48 /	.72

Polyamide

Zytel molding powder	lb.	1.60 /	2.00

Polyester

Atlac 363E-02Z, -12Z	lb.	.66 /	.69
-32Z	lb.	.68 /	.71
382E	lb.	.57 /	.60
FP	lb.	.66 /	.69
Diall 50-01, -51	lb.	3.00 /	3.50
51-01	lb.	.76 /	.90
52-01	lb.	1.88 /	2.50
52-20-30	lb.	1.30	
Hetron	lb.	.43 /	.485
Plaskon 911, 920	lb.	.55 /	.665
941, 942, 951, 9411	lb.	.35 /	.465
943	lb.	.41 /	.525
9404	lb.	.365 /	.48
9406	lb.	.355 /	.465
9500, 9510, 9511	lb.	.35 /	.465
9600	lb.	.44 /	.555
Pre-Imp	lb.	.68 /	.85
Thermaflow 100T	lb.	.62 /	1.05
120	lb.	.89 /	1.25
200T, 300T	lb.	.62 /	1.05
400T, 500T	lb.	.70 /	1.10
Vibrin No. 112	lb.	.40 /	.515
114, 117, 118, 151, 152	lb.	.35 /	.465
115 A	lb.	.38 /	.495
121	lb.	.46 /	.575
135	lb.	3.00	
142	lb.	.55 /	.665
152	lb.	.365 /	.48
X-1029	lb.	.35 /	.465
X-1055B	lb.	.62 /	.73
X-1633A	lb.	.49 /	.605
X-1636W	lb.	.585 /	.70

Polyethylene

A-C No. 6, 617	lb.	.30 /	.37
No. 6A, 7, 617A	lb.	.35 /	.42
No. 615, G-201	lb.	.38 /	.45
No. 629	lb.	.40 /	.47
No. 729	lb.	.45 /	.52
Alathon	lb.	.41 /	.505
Bakelite DE Series	lb.	.43 /	.725
DYGT	lb.	.54 /	.69
DYLT, DYNF, DYNH	lb.	.41 /	.59
DYNJ	lb.	.44 /	.62
DYNK	lb.	.45 /	.63
Celanese film, rolls	lb.	.61	
Sheets	M. sq. in.	.033 /	.257
Sheeting, rolls	lb.	.85 /	.98
Sheets	lb.	.98 /	1.15
Tenite Group 1	lb.	.41 /	.45
Group 2	lb.	.43 /	.47
Group 3	lb.	.46 /	.50
Group 4	lb.	.39 /	.43
Group 5, 6	lb.	.50 /	.72
Group 7	lb.	.60 /	.82
Group 8	lb.	.70 /	.92

Styrenes

Ampacet, crystal	lb.	.315 /	.335
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	.75
Pearl	lb.	.41 /	.75
Phosphorescent	lb.	.695 /	1.00
Tinsel	lb.	.41 /	.67
Confetti	lb.	.51 /	.70
Bakelite RMD Series	lb.	.45 /	.74
Special colors	lb.	.50 /	.785
SMD series, crystal	lb.	.305 /	.325
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	.54
TMD series	lb.	.33 /	.48
Special colors	lb.	.36 /	1.05
Catalin, high impact, natural	lb.	.325 /	.355
Colors, std.	lb.	.355 /	.385
Special	lb.	.36 /	1.00
Medium impact, natural	lb.	.325 /	.355
Colors, std.	lb.	.355 /	.385
Special	lb.	.355 /	1.00
Regular grade, crystal	lb.	.305 /	.325
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	1.00
Utility black	lb.	.18 /	.235
Cycolac 12769 A, 12877, 12968, 12982	lb.	.73 /	.81
12803	lb.	.65 /	.73
12830, 12967	lb.	.70 /	.78
12876 A	lb.	.69 /	.77
12981	lb.	.78 /	.86
12983	lb.	.76 /	.84
12984	lb.	.77 /	.85
13022	lb.	.72 /	.80
Darex Copolymer 3	lb.	.47 /	.67
43G, X34	lb.	.42 /	.61
Latices 3L, 34L, 616L	lb.	.335 /	.48
610L	lb.	.30 /	.46
Dow Latex, polystyrene	lb.	.30 /	.46
Latices, styrene/butadiene	lb.	.30 /	.46
Koppers, Fibertuff	lb.	.55 /	1.505
MC-185 series	lb.	.33 /	.355
-300 series	lb.	.33 /	1.005
-400 series	lb.	.355 /	1.005
Regular, crystal	lb.	.295 /	.315
Colors, std.	lb.	.335 /	.355
Special	lb.	.335 /	1.005
Pearl	lb.	.41 /	1.005
Phosphorescent	lb.	.695 /	2.005
Lustrex Hi-Test 88, std.	lb.	.36 /	.395
Special colors	lb.	.36 /	1.005
L, crystal, gran.	lb.	.305 /	.33
Pelleted	lb.	.305 /	.33
Colors, std.	lb.	.345 /	.37
Special	lb.	.345 /	1.005
LHA, colorant blend	lb.	.325 /	.36
Colors, std.	lb.	.355 /	.39
Special	lb.	.355 /	1.005
Utility black, gen. purpose	lb.	.18 /	.185
High impact	lb.	.235 /	.24
Medium impact	lb.	.19 /	.195
Marbon resins	lb.	.39 /	.46
Plio-Tuf G75C, G85C	lb.	.52 /	.55
Styron 475, natural	lb.	.33 /	.35
Colors, std.	lb.	.36 /	.38
Special	lb.	.36 /	1.00
Sheets, std.	lb.	.55 /	.60
Special	lb.	.55 /	.62
480, natural, black	lb.	.38 /	.40
Colors, std.	lb.	.41 /	.43
Special	lb.	.41 /	1.00
647, crystal	lb.	.305 /	.32
Colors, special	lb.	.345 /	1.34
666, 688, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
700, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
777 colors, std.	lb.	.355 /	.375
Special	lb.	.355 /	1.00

Urea

Admirez SP-30	lb.	.27	
UP-50	lb.	.105	
Plaskon molding cmpds.:			
Colors, single	lb.	.1875/	.30
Special	lb.	.30 /	.62
Standard	lb.	.30 /	.52
Foundry resins, liquid	lb.	.10 /	.13
Powdered	lb.	.2325/	.2525

Vinyls

Bakelite VG Series	lb.	.37 /	.685
Blacar No. BW-60	lb.	.315 /	.385
NEMA colors	lb.	.355 /	.425
No. BW-80	lb.	.405 /	.455
NEMA colors	lb.	.445 /	.495
No. PC white, ivory, black	lb.	.285 /	.335
Other colors	lb.	.325 /	.375
Darex Everplex A (wet wt.)	lb.	.21 /	.39
B (wet wt.)	lb.	.22 /	.40
G (wet wt.)	lb.	.21 /	.39
Copolymer Y (wet wt.)	lb.	.245 /	.28
PVA Emulsions (wt. wt.)	lb.	.19 /	.355
Diamond PVC-45, -50	lb.	.38 /	.44
Dow PVC-100, -111	lb.	.38 /	.57
Exon 402A, 450, 468, 500, 900A, 905, 915, 925	lb.	.38 /	.56
400XR-61	lb.	9.75	
470	lb.	9.55	
471	lb.	9.50	
654 plastisol	lb.	.41 /	.59
700XR-59 latex	lb.	.38 /	.44
Formvar	lb.	.865 /	1.03
Gelva emulsions	lb.	.19 /	.205
Granules	lb.	.4175/	.6175
Geon color masterbatches	lb.	2.00 /	2.75
Extrusion cmpd. 2042, white, ivory	lb.	.375 /	.61
NEMA colors	lb.	.425 /	.66
2046 black	lb.	.375 /	.61
6373 black, white, nat.	lb.	.42 /	.655
NEMA colors	lb.	.47 /	.705
6461 black, white, nat.	lb.	.465 /	.625
Colors	lb.	.515 /	.675
8550 transparent	lb.	.54 /	.67
8600 black, white, ivory	lb.	.405 /	.565
NEMA colors	lb.	.455 /	.615

8620 black, white, ivory, brown	lb.	.405 /	.565
Gray, green, red	lb.	.455 /	.615
8630 black, white, nat.	lb.	.565 /	.725
Colors	lb.	.615 /	.775
8650 black, white, nat.	lb.	.44 /	.60
8656 black, nat.	lb.	.565 /	.725
8677 black	lb.	.545 /	.705
8720 black, gray, nat.	lb.	.735 /	.895
8737 black, nat.	lb.	.435 /	.595
8740 black, white, nat.	lb.	.405 /	.565
Latex 151,251	lb.	.34 /	.40
351	lb.	.38 /	.44
352	lb.	.36 /	.42
552	lb.	.415 /	.475
576	lb.	.39 /	.45
652	lb.	.41 /	.47
Molding cmpd. 8372 black, white	lb.	.405 /	.64
Colors	lb.	.455 /	.69
8539 black, white, gray, nat.	lb.	.42 /	.655
Colors	lb.	.44 /	.675
8640	lb.	.435 /	.67
8643	lb.	.405 /	.64
8679, 8726, 8727, 8728, 8729, 8731	lb.	.42 /	.655
Polyblends	lb.	.475 /	.575
Resin 101, 101EP, 103EP, 126, 202, 205, 400X65, 400X74L, 400X78	lb.	.38 /	.56
121	lb.	.41 /	.59
200X20	lb.	.42 /	.60
404HI	lb.	.43 /	.61
400X80	lb.	.46 /	.64
400X10	lb.	.44 /	.62
Krene, film	lb.	.56 /	.71
Sheeting	lb.	.55 /	.66
Marvinols	lb.	.38 /	.54
Opalon dry blends	lb.	.33 /	.72
Profile extrusion cmpds	lb.	.37 /	.805
Resin 300	lb.	.38 /	.56
410	lb.	.41 /	.59
Wire cmpds.	lb.	.33 /	.77
Plastiflex, std.	lb.	.90 /	1.10
Novelty	lb.	1.15 /	1.50
Pliovic resins	lb.	.38 /	.40
Satinflex	lb.	1.15 /	1.50

Vinylidine

Dow Latex 744-B	lb.	.30 /	.46
Saran formulation 115, black, nat.	lb.	.39 /	.52
Colors	lb.	.44 /	.69
720 nat.	lb.	.41 /	.54
Colors	lb.	.46 /	.71
747 nat.	lb.	.395 /	.525
761 nat.	lb.	.39 /	.52
Colors	lb.	.44 /	.69
820 nat.	lb.	.42 /	.55
Colors	lb.	.47 /	.60
Latices	lb.	.45 /	.61
Resin F 120	lb.	.58 /	.65

Plasticizers

Adipol 2EH, 10A, 810	lb.	.435 /	.465
BCA	lb.	.45 /	.475
ODY	lb.	.48 /	.51
XX	lb.	.435 /	.465
Barrett dibutyl phthalate	lb.	.30 /	.34
Dimethyl phthalate	lb.	.275 /	.306
Benzoflex 2-45	lb.	.26 /	.29
9-88	lb.	.32 /	.35
Cabflex DDA	lb.	.435 /	.515
DDP, Di-OP, DOP, ODP	lb.	.305 /	.385
Di-BA, Di-OA, DOA, ODA	lb.	.435 /	.515
Di-OZ	lb.	.48 /	.5575
Cabol 100	lb.	.02 /	.11
Chlorowax 40	lb.	.155 /	.165
70	lb.	.18 /	.19
70S	lb.	.21 /	.22
LV	lb.	.175 /	.185
Darex dibutyl phthalate	lb.	.30 /	.33
DIOP	lb.	.305 /	.355
DOP	lb.	.305 /	.335
Dinopol 235	lb.	.335 /	.365
IDO	lb.	.305 /	.335
MOP	lb.	.32 /	.35
Dow Plasticizer No. 5	lb.	.315 /	.54
Resin 276-V2, -V9	lb.	.265 /	.325
Drapex 3.2	lb.	.44 /	.49
Elastex 10-P, 28-P	lb.	.305 /	.336
40-P	lb.	.27 /	.31
50-B	lb.	.25 /	.29
80-P	lb.	.295 /	.326
90-P	lb.	.305 /	.335
DCHP	lb.	.59 /	.61
Ethox	lb.	.43 /	.455
Flexol 2GB	lb.	.35 /	.3775
3G	lb.	.53 /	.55
3GH	lb.	.44 /	.46
4GO	lb.	.325 /	.355
8N8	lb.	.355 /	.385
77-G	lb.	.32 /	.35
426	lb.	.27 /	.30
810, 812, CC-55, DOP	lb.	.305 /	.335
A-26,	lb.	.425 /	.455
B-400	lb.	.25 /	.28
R2H	lb.	.59 /	.595
TOF	lb.	.435 /	.465
TWS	lb.	.41 /	.4375
Flexricin P-4	lb.	.30	
P-6	lb.	.36	
P-8	lb.	.32	
Good-rite GP-261	lb.	.305 /	.460
GP-233	lb.	.435 /	.585
Kapsol	lb.	.3225/	.3525
KP-23	lb.	.29 /	.32
-90	lb.	.45 /	.48
-140	lb.	.46 /	.485
-201	lb.	.5825/	.5925
-220	lb.	.31 /	.34
-555	lb.	.45 /	.475
Kronisol	lb.	.33 /	.355
Kronitex AA, I, K-3, MX	lb.	.33 /	.36
Marvinol decylbutyl phthalate	lb.	.27 /	.30
Dibutyl phthalate	lb.	.30 /	.33
Sebacate	lb.	.665 /	.69
Diisooctyl adipate	lb.	.435 /	.465
Phthalate	lb.	.305 /	.335
Dinonyl adipate	lb.	.445 /	.475
Dioctyl adipate	lb.	.435 /	.465
Phthalate	lb.	.305 /	.365
Sebacate	lb.	.615 /	.64
Epoxy plasticizer	lb.	.345 /	.37
Isooctyl decyl phthalate	lb.	.305 /	.335
Tricresyl phosphate	lb.	.33 /	.36
Methox	lb.	.385 /	.41
Ohio-Apex butyl oleate	lb.	.2325/	.26
Stearate	lb.	.22 /	.25
Diallyl phthalate	lb.	.4975/	.5225
Dicapryl phthalate	lb.	.295 /	.325
Di-Carbitol phthalate	lb.	.40 /	.425
Dioctyl phthalate	lb.	.305 /	.335
D.I.O.P.	lb.	.305 /	.335
Tributyl phosphate	lb.	.50 /	.53
Ohopex Q-10	lb.	.295 /	.325
R-9	lb.	.3525/	.3775
Pfizer acetyl tributyl citrate, tech.	lb.	.32 /	.57
Acetyl triethyl citrate, tech.	lb.	.36 /	.57
Triethyl citrate	lb.	.4575/	.58
Plastolein 9050 DHZ	lb.	.52 /	.555
9055 DGP	lb.	.28 /	.315
9057 DIOZ	lb.	.48 /	.515
9058 DOZ	lb.	.48 /	.515
9250 THFO	lb.	.3425/	.3775
9715 Polymeric	lb.	.37 /	.405
9720 Polymeric	lb.	.37 /	.405
PX-104	lb.	.30 /	.39
-108, -118, -138	lb.	.305 /	.395
-114	lb.	.27 /	.36
-208, -238	lb.	.435 /	.525
-209	lb.	.445 /	.535
-404	lb.	.665 /	.75
-438	lb.	.615 /	.70
-809	lb.	.345 /	.43
-917	lb.	.33 /	.42
Pycal 40	lb.	.3875/	.4375
60	lb.	.60 /	.635
62	lb.	.80 /	.835
94	lb.	.3275/	.3775
140	lb.	.35 /	.40
170	lb.	.275 /	.325
194	lb.	.2775/	.3275
Staflex AX	lb.	.43	
BR	lb.	.26 /	.29
CP	lb.	.28 /	.31
DBES, DOS	lb.	.61 /	.635
DIOA, ODA	lb.	.435 /	.465
DIOP, DOP, MP	lb.	.305 /	.335
DOZ	lb.	.48 /	.5075
IXA	lb.	.32 /	.35
KA	lb.	.36 /	.3875
KD	lb.	.44 /	.4675
Witcizer #100	lb.	.26 /	.27
#101	lb.	.31 /	.32
#200	lb.	.195 /	.205
#201	lb.	.235 /	.245
#300	lb.	.30 /	.33
#312, 313	lb.	.305 /	.33
#412	lb.	.435 /	.465

Solvents

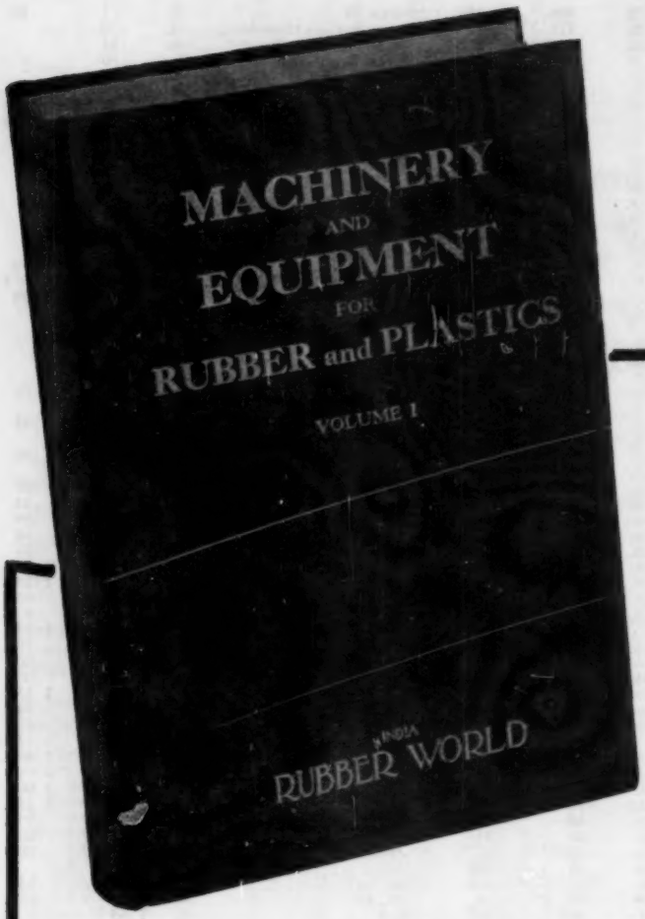
Enjay acetone	gal.	.075 /	.105
Diisobutylene	gal.	.08 /	.11
Isopropyl acetate	gal.	.10 /	.13
Methyl ethyl ketone	gal.	.11 /	.14
Secondary butyl acetone	gal.	.1075/	.1375
Butyl alcohol	gal.	.11 /	.14
Petrohol 91%	gal.	.35 /	.55
95%	gal.	.37 /	.57
99%	gal.	.39 /	.59

Stabilizers

Advastab #21	lb.	1.00 /	1.18
New	lb.	.80 /	.90
Barca 10	lb.	.75 /	.80
Baker barium ricinoleate	lb.	.70	
Calcium ricinoleate	lb.	.55	
Dutch Boy Barinac	lb.	.70	
Calstar	lb.	.36	
CS-137	lb.	1.25	
DS-207	lb.	.54 /	.555
Dyphos	lb.	.57 /	.585
50A	lb.	.335	
Dythal	lb.	.395 /	.41
L-26	lb.	.50	
Leadstar	lb.	.39	
Normal lead maleate	lb.	.4475	
Normasal	lb.	.46	
Pearlescent pigment	lb.	1.00	
Plumb-O-Sil-A	lb.	.2975	
-B	lb.	.3125/	.36
-C	lb.	.3425/	.375
Tribase	lb.	.265 /	.28
-E	lb.	.215	
Trimal	lb.	.435	
Metasap 613-A	lb.	.69	
613-B	lb.	.84	
613-C	lb.	1.06	
621	lb.	.88	
624	lb.	.75	
Cadmium stearate	lb.	1.40 /	1.44
Fused stearates, calcium 602-A	lb.	.25 /	.30
Dibasic lead stearate	lb.	.56	
Lead 611	lb.	.32 /	.37
Lead stearate	lb.	.39 /	.44
Nuostabe V-1	lb.	.54 /	.59
V-2	lb.	.39 /	.44
V-10	lb.	.70 /	.75
V-20	lb.	1.30 /	1.35
V-21	lb.	1.29 /	1.34
V-30	lb.	.90 /	.95
V-31	lb.	.80 /	.85
V-40	lb.	1.18 /	1.23
V-42	lb.	.65 /	.70
V-43	lb.	.75 /	.80
V-44	lb.	.90 /	.95
V-45	lb.	1.10 /	1.15
V-50	lb.	.49 /	.54
V-60	lb.	.37 /	.42
V-70	lb.	.68 /	.73
V-80	lb.	2.80 /	2.85
V-81	lb.	2.90 /	2.95
Stabilizer #3, 52	lb.	1.90 /	2.00
17-M	lb.	3.00 /	3.25
#42	lb.	.83 /	.93
89-X	lb.	.75 /	.80
#143	lb.	.80 /	.90
A-5	lb.	1.25	
BC-12	lb.	.87 /	.95
BC-105	lb.	.75 /	.85
C-2	lb.	1.65	
C-77	lb.	.85 /	.95
CH-14	lb.	.63 /	.70
CH-20	lb.	.63 /	.65
D-22	lb.	1.99 /	2.05
E-6-B	lb.	.80 /	.90
E-49	lb.	.60 /	.65
E-98	lb.	.55 /	.65
JCX	lb.	.62 /	.68
L-Paste	lb.	.60 /	.65
Mark E	lb.	.72 /	.85
M	lb.	.73 /	.83
PL	lb.	.74 /	.84
TT	lb.	.77 /	.91
V	lb.	.91 /	1.04
X	lb.	2.50 /	2.75
XI	lb.	.87 /	1.01
XV	lb.	.92 /	1.01
XX	lb.	.63 /	.74
OM-10	lb.	1.90 /	2.00
-18	lb.	3.10 /	3.35
P-1835	lb.	3.20 /	3.35
PS-38	lb.	.50 /	.65
SN	lb.	.47 /	.53
T-72	lb.	3.20 /	3.35
V-I-N	lb.	.40 /	.48
VL-3	lb.	.95 /	1.05
Staflex QMXA	lb.	.70	
50% in DOP	lb.	.52	
OV	lb.	1.00 /	1.20
Stayrite #10	lb.	.33 /	.37
#15	lb.	.54 /	.57
#20	lb.	.38 /	.42
#22	lb.	1.32 /	1.34
#25	lb.	.36 /	.40
#229	lb.	.47 /	.50
#70, 75, 80, 90	lb.	.69 /	.70
P-10	lb.	.40 /	.44
Thermolite No. 12	lb.	2.00 /	2.25
13	lb.	3.10 /	3.78
31	lb.	3.05 /	3.25
15	lb.	4.13	
17, 99	lb.	3.00	
20	lb.	3.25	

Wetting Agents

Poly-lube No. 4	gl.	1.45 /	1.94



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